MARCH 1989 / $2.50

NEW

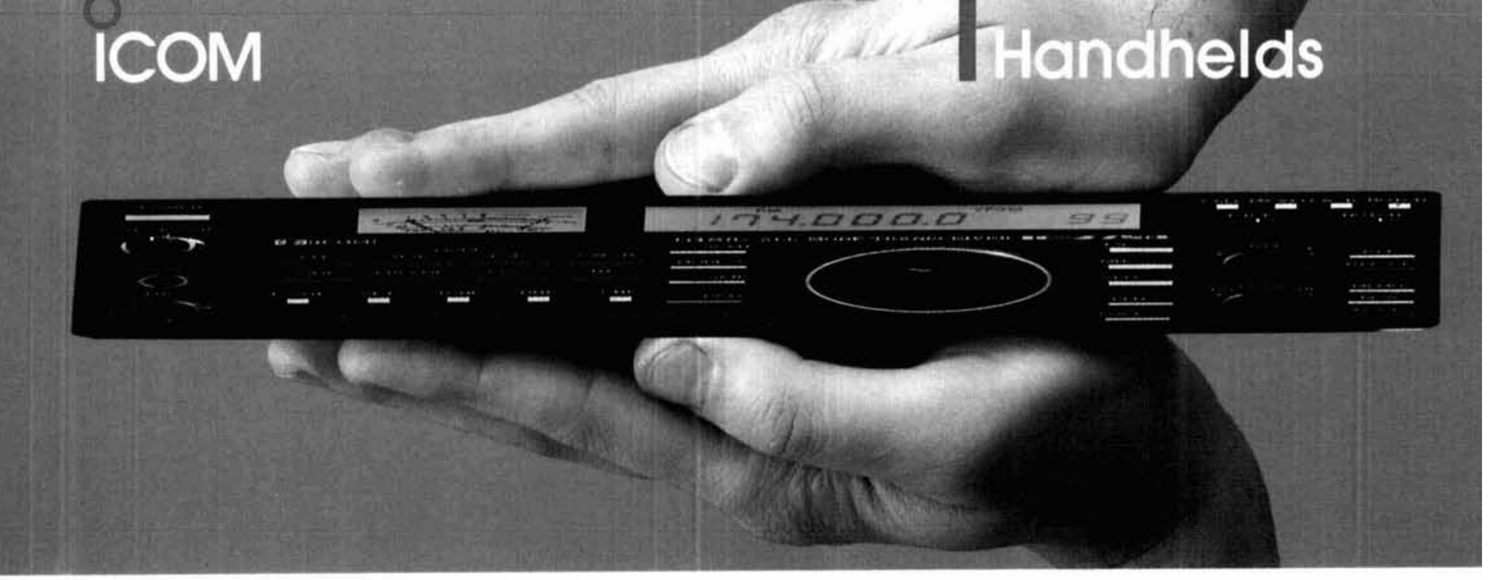
HAM RADIO

kender Projects:

- Solo-16 Acoustic CW Speaker
- DTMF Group Call Decoder

Also... *The Heathkit Seneca as a 2-Meter FM Amplifier*

Plus... *Your favorite columnists, Ham Notes, New Products, and more!*



HOW DO YOU PACK 7 WATTS, 20 MEMORIES AND SCANNING INTO A HANDHELD?

IC-2GAT: 7 Watts Rx 138-174MHz; Tx 140-150MHz
IC-4GAT: 6 Watts 440-450MHz
IC-32AT: 5 Watts Rx 138-174MHz/440-450MHz; Tx 140-150MHz/440-450MHz

A New Generation of Powerful, Versatile Handhelds.

Select a new "G Series" or dual band ICOM transceiver and enjoy full base station luxury in a portable unit designed especially for you!

- **Maximum Frequency Coverage.** The IC-2GAT receives 138-174MHz, including NOAA, and transmits 140-150MHz to include CAP and MARS frequencies. The IC-4GAT operates 440-450MHz, and the IC-32AT receives 138-174MHz and operates 140-150MHz/440-450MHz.
- **Most Powerful Handheld!** The IC-2GAT delivers seven watts! The IC-4GAT is six watts and the IC-32AT is five watts! One watt level selectable for local QSO's.
- **20 Memories.** Store any frequency, Tx offset and subaudible tone in any memory. Total flexibility!
- **Programmable Scanning** of band and memories plus easy lockout and instant memory recall.
- **Additional Features.** Battery saver, call channel, all subaudible tones, multi-function LCD readout and DTMF pad.
- **Compatible Accessories.** All ICOM IC-2AT/02AT series battery packs, headsets and speaker mics are interchangeable.
- **Optional UT-40 Beeper** silently monitors a busy channel for your calls. When the pre-programmed subaudible tone is received, the unit beeps and the LCD flashes.

IC-32AT 2 Meters and 440MHz | **IC-2GAT** 2 Meters | **IC-4GAT** 440MHz

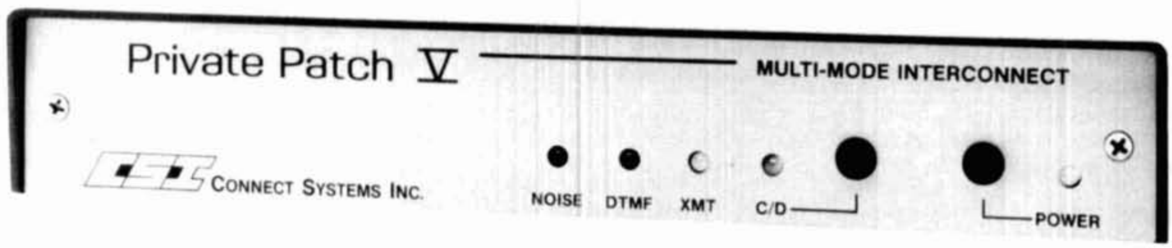
ICOM
First in Communications

ICOM America, Inc., 2380-116th Ave. N.E., Bellevue, WA 98004
Customer Service Hotline (206) 454-7619
3150 Premier Drive, Suite 126, Irving, TX 75063
1777 Phoenix Parkway, Suite 201, Atlanta, GA 30349
ICOM CANADA, A Division of ICOM America, Inc., 3071 - #5 Road, Unit 9, Richmond, B.C. V6X 2T4 Canada

All stated specifications are subject to change without notice or obligation. All ICOM radios significantly exceed FCC regulations limiting spurious emissions. HH488.

FOUR user selectable operating modes and a 90 number autodialer make Private Patch V the ONLY choice!

NEW!



SELECT AN OPERATING MODE USING THE BUILT-IN KEYBOARD . . .

1. SIMPLEX SAMPLING PATCH

Private Patch V achieves a level of sampling patch performance unobtainable in any other product. Crucial to performance is the noise squelch filter. Compare our five pole filter to the competition's two pole filter. Advanced software algorithms perform noise correlation tests which result in greater useable range than the competition. Nine selectable VOX enhancement ratios allow you to vary performance from straight sampling to highly VOX enhanced. (sampling rate decreased while the land party is speaking). The mobile is in full control and can break-in at any time.

2. SIMPLEX VOX PATCH

VOX mode offers superb simplex operation with any radio, including synthesized and relay switched models. VOX mode has other advantages too. **1.** A linear amplifier can be used to extend straight simplex range. **2.** You can operate through any remotely located repeater to greatly extend range. **3.** If desired you can connect Private Patch V to the MIC and speaker jack of your radio. NO INTERNAL CONNECTIONS ARE REQUIRED. Control is maintained automatically with built-in dial tone detection, busy signal detection and fully programmable activity and time out timers. An optional electronic voice delay board eliminates first word clipping with slow switching radios.

3. DUPLEX PATCH

Select duplex mode when connecting Private Patch V to your existing repeater or duplex base station. Many features including semi-duplex privacy mode are user programmable. The mobile is in full control at all times.

4. REPEATER CONTROLLER

Private Patch V will convert any receiver and transmitter into an outstanding performing repeater with duplex autopatch. Features such as repeater on/off code, hangtime, activity timer time, CW ID interval etc. are fully user programmable. Private Patch V is the right choice for your club system.

Private Patch V is a totally new concept in automatic phone patches. A built-in keyboard and menu driven display allow you to customize all modes, features, and functions specifically to *your application.*

Private Patch V can be a sampling patch today. A VOX patch tomorrow. And a repeater controller next year!

You may never need another patch again.

COMPARE THESE FEATURES . . .

- 90 phone number autodialer
- Last number redial
- Regenerated tone/pulse dialing
- Toll restrict: 1st and 2nd digit restrict, prefix lockout and digit counting
- 1-5 digit connect/disconnect code
- 2-5 digit secret toll override code
- User programmable CW ID
- Remote hook flash
- Auto disconnect on dialtone/busy signals
- Telephone remote base
- Remote controlled relay (relay optional)
- Lightning protected

Call or write today for your FREE brochure.

CONNECT SYSTEMS INC.

2064 Eastman Ave., #113 Ventura, CA 93003

Phone (805) 642-7184 FAX (805) 642-7271

AMATEUR ELECTRONIC SUPPLY: Milwaukee WI, Wickliffe OH, Orlando FL, Clearwater FL, Las Vegas NV • **BARRY ELECTRONICS CORP.:** New York NY • **ERICKSON COMMUNICATIONS:** Chicago IL • **HAM RADIO OUTLET:** Anaheim CA, Burlingame CA, Oakland CA, Phoenix AZ San Diego CA, Van Nuys CA, Atlanta GA • **HENRY RADIO:** Los Angeles CA • **INTERNATIONAL RADIO SYSTEMS:** Miami FL • **JUNS ELECTRONICS:** Culver City CA • **MADISON ELECTRONICS SUPPLY:** Houston TX • **MIAMI RADIO CENTER CORP.:** Miami FL • **MIKES ELECTRONICS:** Ft. Lauderdale, FL • **N&G DISTRIBUTING CORP.:** Miami FL • **OMNI ELECTRONICS:** Laredo TX • **PACE ENGINEERING:** Tucson AZ • **THE HAM STATION:** Evansville IN • **VALLEY RADIO CENTER:** Harlingen TX • **CANADA—COM-WEST RADIO SYSTEMS, LTD.:** Vancouver BC

✓ 122

KENWOOD

...pacesetter in Amateur Radio

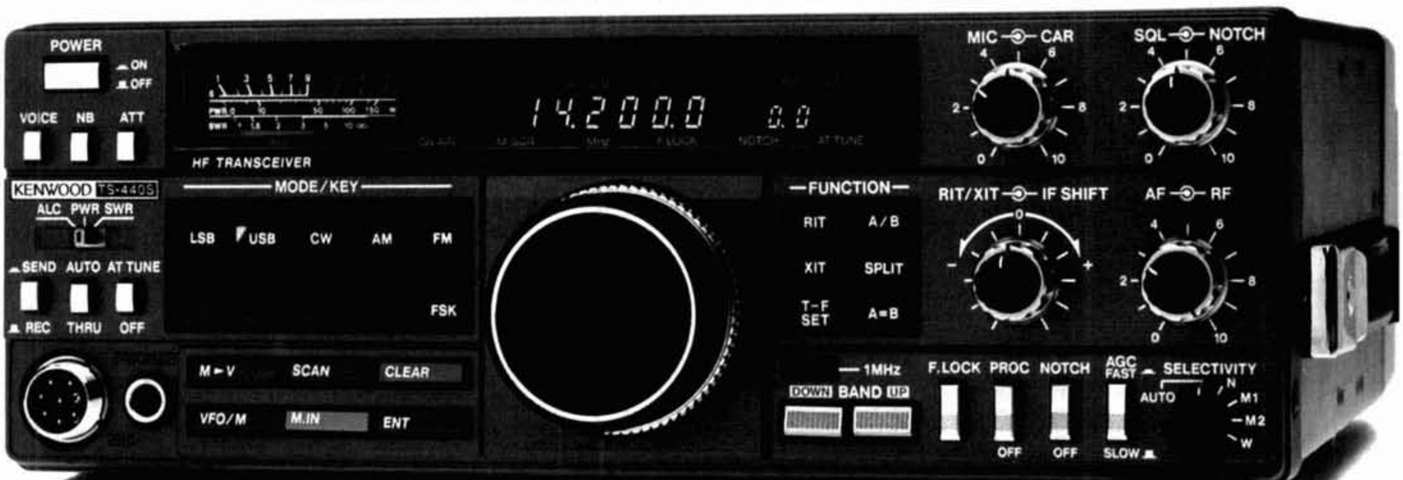
All New Compact HF!

"DX-citing!"

TS-440S Compact high performance HF transceiver with general coverage receiver

Kenwood's advanced digital know-how brings Amateurs world-wide "big-rig" performance in a compact package. We call it "Digital DX-citement"—that special feeling you get every time you turn the power on!

- **Covers All Amateur bands**
  General coverage receiver tunes from 100 kHz–30 MHz. Easily modified for HF MARS operation.
- **Direct keyboard entry of frequency**
- **All modes built-in**
  USB, LSB, CW, AM, FM, and AFSK. Mode selection is verified in Morse Code.
- **Built-in automatic antenna tuner (optional)**
  Covers 80-10 meters.
- **VS-1 voice synthesizer (optional)**
- **Superior receiver dynamic range**
  Kenwood DynaMix™ high sensitivity direct mixing system ensures true 102 dB receiver dynamic range. (500 Hz bandwidth on 20 m)
- **100% duty cycle transmitter**
  Super efficient cooling permits continuous key-down for periods exceeding one hour. RF input power is rated at 200 W PEP on SSB, 200 W DC on CW, AFSK, FM, and 110 W DC AM. (The PS-50 power supply is needed for continuous duty.)
- **Adjustable dial torque**
- **100 memory channels**
  Frequency and mode may be stored in 10 groups of 10 channels each. Split frequencies may be stored in 10 channels for repeater operation.
- **TU-8 CTCSS unit (optional)**
- **Superb interference reduction**
  IF shift, tuneable notch filter, noise blanker, all-mode squelch, RF attenuator, RIT/XIT, and optional filters fight QRM.
- **MC-43S UP/DOWN mic. included**
- **Computer interface port**
- **5 IF filter functions**
- **Dual SSB IF filtering**
  A built-in SSB filter is standard. When an optional SSB filter (YK-88S or YK-88SN) is installed, **dual** filtering is provided.
- **VOX, full or semi break-in CW**
- **AMTOR compatible**



Optional accessories:
• AT-440 internal auto. antenna tuner (80 m–10 m) • AT-250 external auto. tuner (160 m–10 m) • AT-130 compact mobile antenna tuner (160 m–10 m) • IF-232C/IC-10 level translator and modem IC kit • PS-50 heavy duty power supply • PS-430/PS-30 DC power supply • SP-430 external speaker • MB-430 mobile mounting bracket • YK-88C/88CN 500 Hz/270 Hz CW filters • YK-88S/88SN 2.4 kHz/1.8 kHz SSB filters • MC-60A/80/85 desk microphones • MC-55 (8P) mobile microphone • HS-5/6/7 headphones • SP-40/50B mobile speakers • MA-5/VP-1 HF 5 band mobile helical antenna and bumper mount • TL-922A 2 kw PEP linear amplifier • SM-220 station monitor • VS-1 voice synthesizer • SW-100A/200A/2000 SWR/power meters • TU-8 CTCSS tone unit • PG-2S extra DC cable.

Kenwood takes you from HF to OSCAR!

Complete service manuals are available for all Kenwood transceivers and most accessories. Specifications and prices are subject to change without notice or obligation.

KENWOOD

KENWOOD U.S.A. CORPORATION
2201 E. Dominguez St., Long Beach, CA 90810
P.O. Box 22745, Long Beach, CA 90801-5745

HAM RADIO

MARCH 1989

volume 22, number 3

HAM RADIO Magazine is published monthly by
Communications Technology, Inc.
Greenville, New Hampshire 03048-0498
Telephone: 603-878-1441

subscription rates

United States:
one year, $22.95; two years, $38.95; three years, $49.95
Europe (via KLM air mail), $40.00
Canada, Japan, South Africa and other countries (via surface mail),
one year, $31.00; two years, $55.00; three years, $74.00

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

international subscription agents: page 95

Microfilm copies are available from
Buckmaster Publishing
Mineral, Virginia 23117

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

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

Send change of address to *HAM RADIO*
Greenville, New Hampshire 03048-0498

FEATURES

W3NNL, page 8

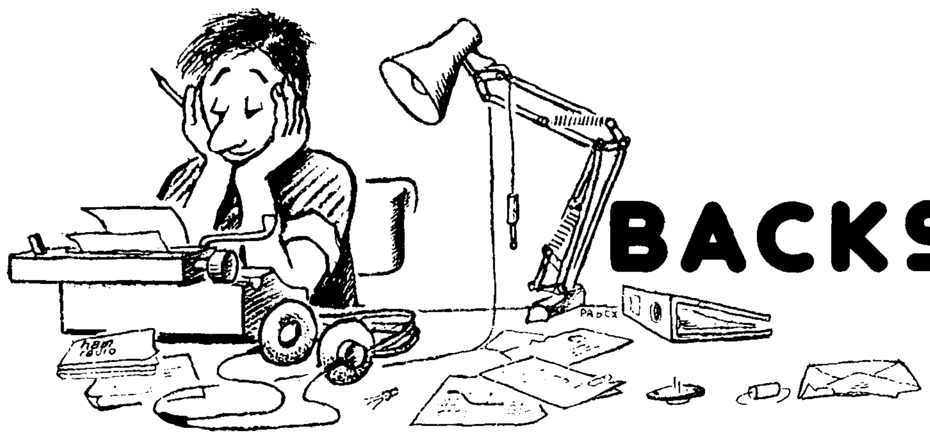
I4MK, page 59

KB1QT, page 12
AA4NX, page 53

On the Cover:
Solo-16 Acoustic CW Speaker.

See page 93 for the winners of January's Weekender contest.

DEPARTMENTS



BACKSCATTER

NO-CODE REVISITED

The no-code license concept has resurfaced in the Amateur Radio press. In the December 1st issue of *W5YI REPORT*, Fred Maia, W5YI, reopened "Pandora's box" and suggested that a no-code license be considered once again. Citing the decreased number of youths interested in becoming hams, several other interrelated factors, and the political climate in Washington, Maia feels that now is the time to actively reconsider no-code.

A number of countries already have no-code VHF licenses; Canada is considering implementing one in the very near future. But what is no-code, really? Is it an attempt to get thousands of new "hams" into the hobby at the expense of those already licensed? Or is it a logical outgrowth of incentive licensing and a step that should have been taken over 20 years ago?

Obviously this is going to be an emotional, highly charged question. The January issue of *QST* has a rather well-balanced editorial discussing code and its applications to the Amateur Radio service. As a democratic organization, the ARRL members are the ones that will make ARRL policy about code. In the last no-code round, letters ran 25 to 1 against the proposal. *QST*'s January 1989 issue, continuing to echo that feeling, contains 13 pro-code letters. Early in January, the League set up a study committee to look at the subject of code. The members are: W4OYI, K1ZZ, and KB6ZV, representing the League; W2GD and KØPP (Montana's SCM) from the general Amateur community; N7ML and W5TOO from the Amateur Radio industry; VE3CDM, CRRL President; and W5KL, QCQA President. Hopefully, this group won't succumb to emotional interests and will take a balanced look at all the issues before making any recommendations to their fellow Amateurs. Arguments can be made for both sides of the controversy. However, does Amateur Radio need growth at this time, or is a 2 to 3 percent per year growth rate adequate? Some Amateurs feel that the bands are already crowded enough and that further growth will be counterproductive to Amateur Radio. Others argue that a basic qualifier, like code, serves as a filter to eliminate those who don't belong in the Amateur ranks. You could make an argument that code at 5 WPM is hardly an insurmountable barrier. I find it of interest that making the theory test easier than the one currently taken by Novices isn't even an issue. (I'd like to know if professionals in the education field think that learning the code is really an impediment to getting a ham license. Or are some people who don't want to put in the effort just looking for a convenient cop-out?)

But the League doesn't represent all licensed Radio Amateurs — in fact less than half of the Amateur population are League members. What about the rest of you; where do you stand?

The current licensing system is based on a series of rewards for diligence and study. It might make sense to give beginners two choices. The no-code license would have *limited* VHF (or UHF) frequencies and voice and data privileges. The other beginner's ticket would have all the current Novice HF bands, and the new class license privileges. By passing a Morse code test, the no-code beginner would be able to upgrade to HF privileges.

I'm certainly not proposing that we eliminate code from the Amateur Radio service entirely. There's no argument that code has been, and will continue to be, a most important mode of communication in Amateur Radio. But is there a continuing need in Amateur Radio for the hurdle of learning the code at the beginner's level? Several years ago, industry pundit Wayne Green petitioned the FCC to make code exams mandatory at license renewal time. The argument was that you've got to learn the code to get a license, so continuing to maintain proficiency is also important. The docket was rejected, but I'd bet you'd find many pro-code adherents scrambling to brush up on long-forgotten CW skills when it was time for them to renew.

It will be interesting to see what happens with the no-code situation over the next few years. I'm sure there will be ample give and take. Maia's proposal deserves study and thought. The emotional argument that "I had to do it — so do they" doesn't hold water with me.

What do you, the *Ham Radio* Magazine readers, think? Are you pro no-code or con? Send me a QSL card with your vote. We'll give you the results in a couple of months.

Craig Clark, N1ACH

COMMENTS

What's in the future for ham radio?

Dear HR

It's not that I'm the kind of fellow who's quick to say "I told you so"; I waited three whole hours!

Of course the ham bands are under siege. It has been obvious to me and to many other concerned hams that Uncle Sam and the communications industry have their eyes on the ham bands, and that they have every intention of obliterating ham radio. Let's face it, we have (as hams) outlived our usefulness.

See your own words referring to ham radio as "our hobby." See the number of publications promoting contests. See the total devastation of ham radio activities during contest periods (contesting is not a proper ham radio activity). See the "appliance operator" nature of the ads in your own magazine (Radio Shack's CB Extension Speaker). See the Dick Bash travesty. See ARRL's VOLMON substitute for FCC policing of the ham bands. See the volunteer examination ripoff.

Listen to the average, trivial "QSOs" and inane "QTCs" that pollute the bands in between contests.

About all hams do these days is provide emergency communications a few times a year, and much of that is so poorly handled.

So, why should "our hobby" fare any better than others' — like fishing, philately, etc.? We are occupying a lot of valuable space in the RF spectrum, but we surely don't deserve it.

See? I told you so.

A.J. (Buddy) Massa, W5VSR,
New Orleans, Louisiana 70174.

What do you think readers? Is Amateur Radio a hobby or a service? What's your opinion? Ed.

A candid opinion

Dear HR

I often wish "letters to the editor" columns in magazines would find something more interesting to print than praise from readers/subscribers. Unfortunately, *HR* is in this category as well.

I am not afraid to be told that my opinion is in the minority, but I will frankly express my opinion that the magazine which once included words to the effect that it was devoted to communications technology has now strayed considerably from that aim.

I just received the annual receiver issue which usually has been, for me, the most interesting one of the year. I think the November issue, in line with an apparent goal to print articles which can describe circuits that can be built simply or inexpensively, is the dullest I have yet seen.

Again, despite a possible majority of PRESENT subscriber interest in the new orientation, I think it's an almost CQ/73 clone now.

Considering the receiver issue, a Dr. Ulrich Rohde would seemingly not be at home with the new orientation.

It is quite correct that the cover no longer emphasizes "communications technology."

Simon L. Scheiner,
Cherry Hill, New Jersey 08034

On the other hand .....

Dear HR

I would like to add some comments about your new format.

I have worked in electronics for more than 22 years, 8 years in supervision, starting out in communications with a FCC license. I have always found your magazine interesting and am interested in projects. However, I find that for the beginner, like some youngster that has a Novice license or whomever, that some articles are very complex needing a knowledge of higher math. I'd like to see some articles on such math as that used in the magazine. I'd like to see articles that deal with projects for the ham station, articles on procedures and operation. In some ways ham radio has left our newer operatives behind. How about a series of articles on the step-by-step construction of a transceiver, including the math needed to design it? That is what ham radio was all about years ago. Some persons would like to experiment, but there is a limit on what they can afford to spend. How about some articles that deal with tuning transmitters to FCC specs, etc. — areas where there is little published information for the new operator.

Thank you for letting me express my views.

William C. Pollard,
Georgetown, Texas 78628

And ....

Dear HR

I surely did enjoy the November 1988 *Ham Radio* especially "Simple Receivers," by Bill Parrott.

I like the direction you are going by putting several projects and circuits in the magazine.

Keep up the good work, but be careful, you may inject some technology back into amateur radio. Hi.

Fenton Wood, KB5VQ, Malakoff, Texas 75148-9613

Memories of the China Clipper

Dear HR

Bill Orr's article, "Ham Radio Techniques," in the November 1988 issue brought back some memories. I lived

(continued on page 109)

KENWOOD

...pacesetter in Amateur Radio

TH-55AT 1200 MHz Here Now!

Compact Breakthrough!

TH-25AT/45AT

New Pocket Portable Transceivers

The all-new TH-25 Series of pocket transceivers is here! Wide-band frequency coverage, LCD display, 5 watt option, plus...

- Frequency coverage: **TH-25AT:** 141-163 MHz (Rx); 144-148 MHz (Tx). (Modifiable for MARS/CAP. Permits required.) **TH-45AT:** 438-450 MHz.
- Automatic Power Control (APC) circuit for reliable RF output and final protection.
- 14 memories; two for **any** "odd split" (5 kHz steps).
- Automatic offset selection (TH-25AT).
- 5 Watts from 12 VDC or PB-8 battery pack.
- Large multi-function LCD display.
- Rotary dial selects memory, frequency, CTCSS and scan direction.
- T-ALERT for quiet monitoring. Tone Alert beeps when squelch is opened.
- Band scan and memory scan.
- Automatic "power off" circuit.
- Water resistant.
- CTCSS encoder/decoder optional (TSU-6).
- **Supplied accessories:** StubbyDuk, PB-6 battery pack for 2.5 watts output, wall charger, belt hook, wrist strap, water resistant dust caps.

Optional accessories:
• **PB-5** 7.2 V, 200 mAh NiCd pack for 2.5 W output • **PB-6** 7.2 V, 600 mAh NiCd pack • **PB-7** 7.2 V, 1100 mAh NiCd pack • **PB-8** 12 V, 600 mAh NiCd for 5 W output • **PB-9** 7.2 V, 600 mAh NiCd with built-in charger • **BC-10** Compact charger • **BC-11** Rapid charger • **BT-6** AAA battery case • **DC-1/PG-2V** DC adapter • **HMC-2** Headset with VOX and PTT • **SC-14, 15, 16** Soft cases • **SMC-30/31** Speaker mics. • **TSU-6** CTCSS decode unit • **WR-1** Water resistant bag

KENWOOD

KENWOOD U.S.A. CORPORATION
2201 E. Dominguez St., Long Beach, CA 90810
P.O. Box 22745, Long Beach, CA 90801-5745

Complete service manuals are available for all Kenwood transceivers and most accessories. Specifications, features, and prices are subject to change without notice or obligation.

THE HEATHKIT SENECA
AS A 2-METER FM AMPLIFIER

Increase your handheld's output power to 70 watts

There are two motives for using old "boat anchors" in modern-day ham radio: nostalgia and low cost. In many applications, the performance of this gear is so inferior to state-of-the-art equipment that its use is undesirable. But now and then you find a use which is both practical and consistent with realistic objectives.

Such was the case when I finally succumbed to the 2-meter bug. My change of heart was prompted by the decline in sunspots and the corresponding difficulty of maintaining communications with the local gang on the DC bands. I found a Heathkit Seneca for $15 at a hamfest and bought it with the idea of getting on 2-meter CW using a GLB converter for receiving.

The 6 and 2-meter Seneca (of early 1960s vintage) has a built-in VFO, which is too unstable for CW, and features controlled-carrier AM, which has no present-day use. However, the rig is attractive in appearance and ruggedly built. With crystal control it yielded a good note and some 70 watts of RF power on 144-MHz CW. The audio and VFO tubes were consigned to the junkbox.

One thing led to another, and I acquired a handheld FM transceiver. This expanded the workable population through repeaters. But the simplex paths, which were easy with the Seneca on CW, were a flop with the handheld — even with a directional antenna. I obviously needed more power. At this point, I devised a way to marry the two gadgets and the Seneca had its first introduction to FM.

The beauty of narrowband FM (in terms of the amplifier's response) is that nothing is happening. There's no change in total input or output power; linearity is of no consequence. Thus, an old-fashioned class-C amplifier works well. The problems in mating the FM transceiver and amplifier are reduced to those of providing output/input compatibility and send/receive switching.

These problems were resolved, and the result was 70 watts of RF on FM and plenty of simplex range. This output, which was achieved with less than 1 watt from the handheld, represented a much larger power gain than that of the typical solid-state "brick" amplifier.

Drive-point choice

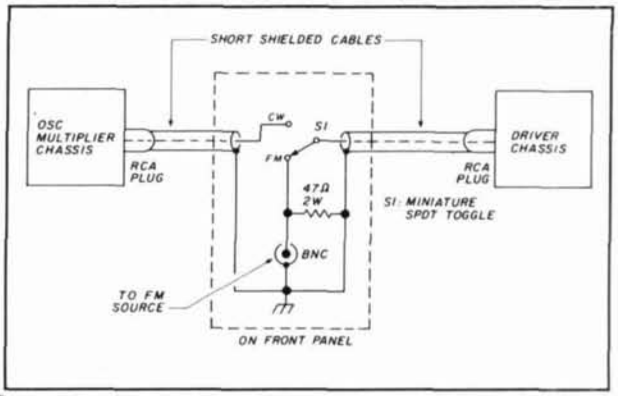
The Seneca uses a pair of 6146s in the output stage, with a 2E26 driver and a 6AN8 crystal oscillator/multiplier tube. The 6146 isn't designed for VHF use; it's hard to drive and somewhat tricky to neutralize and adjust. On the other hand, the 2E26 (which normally acts as a doubler from 72 MHz) drives easily and is well behaved. I decided to insert the FM transceiver output at the 2E26 grid.

This is a convenient drive point because the 2E26 grid tank is also the plate tank of the multiplier section of the 6AN8. The 6AN8 is located in the oscillator/multiplier subchassis and output is fed to the driver/final compartment through a short length of coax and RCA phono plugs. Interruption of this path provides direct access to the 2E26 grid with no tuned circuit present.

The voltage developed by 1 watt into 50 ohms is more than sufficient to drive the 2E26 as a straight-through stage at 144 MHz. The use of a resistively terminated drive avoids a tuned circuit and sidesteps parasitic oscillation at the common input and output frequency. A 47-ohm, 2-watt resistor does the job. In my setup (**fig. 1**), an SPDT toggle switch permits switching between FM

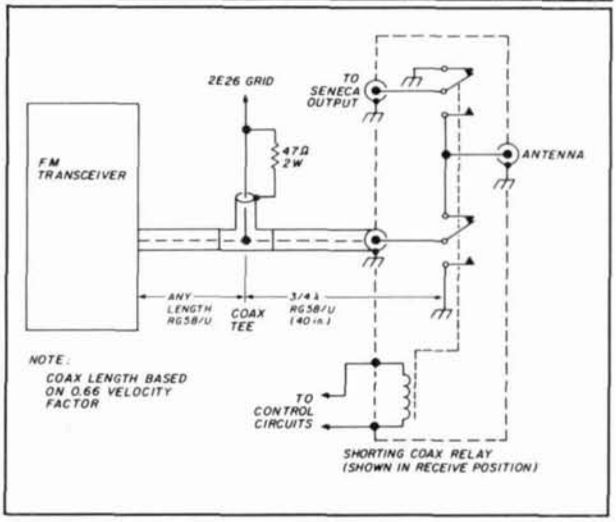
By **Clifford J. Bader, W3NNL,** 1209 Gateway Lane, West Chester, Pennsylvania 19380

FIGURE 1



FM drive insertion method.

FIGURE 2



Antenna switching.

and crystal-controlled CW. Those interested in FM only can dispense with this frill.

Antenna switching

The least obvious problem, as usual, turned out to be the most formidable. T/R switching involves getting the received signal back to the handheld, while inserting the amplifier during transmit. A DPDT coax relay is an obvious solution, but the only one available was a 24-volt DC, single-pole shorting type. I pressed it into service after adding an isolating section of transmission line. The combination does the switching with an insignificant loss of received signal.

Switching sequence

The system (**fig. 2**) works as follows: The transceiver input/output line runs to a T connector on the front panel of the Seneca, where it picks up the 47-ohm load in parallel with the 2E26 grid. From there, an additional three-quarter electrical wavelength (about 40 inches) of RG-58/U coax runs to the receive side of the relay. In the transmsit mode the relay shorts the coax, which then appears as an open circuit at the 47-ohm load because an odd number of quarter wavelengths intervene. (A quarter-wavelength section could be used but would be inconveniently short.) Thus, 47 ohms is presented to the transceiver and no drive power is lost.

In receive mode the 47 ohms represent a spurious load, which causes approximately 3-dB loss of received signal. With anything but already marginal signals, such a loss is negligible. In a desperate situation the T connector can be disconnected from the Seneca for receiving, but I've never found this to be necessary. The same basic approach could be employed with a non-shorting relay by using a half-wave line or multiple thereof.

Transmitter control

Another aspect of T/R switching is transmitter control. The Seneca uses a 115-volt, externally controllable AC relay to ground the center tap of the high-voltage supply during transmit periods. With voltage (but in the absence of excitation), final current is limited by a 6AQ5 clamp tube, which pulls the screen voltage to a low value.

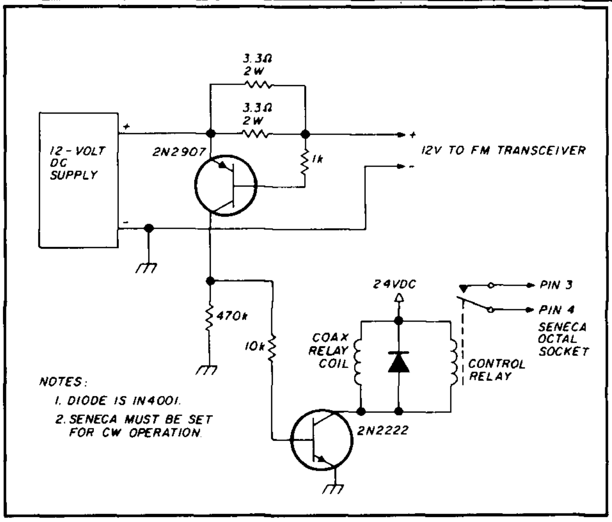
PHOTO A

The Heathkit Seneca as a 2-meter FM amplifier for a handheld transceiver.

While it would be possible to keep the transmitter powered up and to merely switch the antenna relay along with the transceiver, there are several advantages to controlling the high voltage. First, the residual current in the final can have noise components, which might couple into the line through stray capacitance and mask weak signals. Second, the residual plate current is high enough to push the 6146s close to their dissipation limits, so the rig runs much cooler if shut down during receive periods. Finally, the amplifier isn't loaded with the proper impedance during receive and under some conditions it might be subject to parasitic oscillations. These oscillations could damage both the amplifier and the transceiver front end.

There are a number of ways in which the amplifier

FIGURE 3



Transmitter control circuit.

power switching can be implemented. The optimum solution depends on the contents of your junkbox or the hamfest goodies you can find. I use a 24-volt DC auxiliary relay (with its coil in parallel with that of the antenna relay) to switch the Seneca's internal T/R relay. The latter is accessed through pins 3 and 4 of the octal socket on the rear apron.

Although it's quite feasible to manipulate a toggle switch to trip the relays and simultaneously work the handheld mike switch, snappy QSOs demand control of the relays from the mike. This can be done either by sensing RF from the transceiver or by sensing the increase in DC power consumption during transmit. The second approach is easy to implement if the transceiver is operated from an AC supply. It also avoids playing around with the RF path.

I use a 12-volt supply and an adapter with the handheld to provide the required 8.4 volts. The circuit (**fig. 3**) uses a 1.65-ohm resistance (two 3.3-ohm, 2-watt resistors in parallel) in series with the positive 12-volt lead to the transceiver. The transmit current of some 600 mA produces sufficient drop to turn on a PNP transistor with its base-emitter junction across the resistors. The PNP, in turn, activates an NPN transistor which energizes the relays. In receive mode, the current is insufficient to overcome the PNP junction drop and the relays drop out.

Operation

Some comments are necessary regarding the operation of the Seneca. On 2 meters, the 6146s are used above their self-neutralizing frequency, and the neutralizing wires are switched to augment rather than cancel the grid-plate capacitance. I found that the correct neutralization (achieved by bending the wires closer to or farther from the tube plates) held only for a limited range of final-grid and plate-tank tuning, and that tuning up at the opposite end of the band was an invitation to instability. The latter is evidenced by the erratic behavior of the final plate current as you tune through the resonant dip.

When the amplifier is tuned and neutralized at 146 MHz, performance is good over most of the band. You can check neutralization by loading the amplifier lightly, and adjusting the uncrossed set of wires symmetrically for a smooth dip as the final tank is tuned through resonance. **Caution**: There are lethal voltages present! Turn off the rig between adjustments and use an insulated tool to bend the wires.

Now load the rig to the normal plate current in the CW mode (I use 200 mA). The final grid current runs about 3 mA in my setup and the tubes show no sign of overheating. (Any reddening of the plates is a sign of impending disaster.) The amplifier works well with grid drive down to 1 mA or so, corresponding to only 150 mW from the transceiver.

The Seneca uses a front-panel adjusted hairpin loop for output coupling to the final tank. Loop reactance is canceled by a series "loading" capacitor. Because the inductance of the loop is increased by the inclusion of a 1-turn link to the 6-meter coil, it may be difficult to achieve sufficient loading of some coaxial lines — even at minimum capacitance. I found it helpful to solder a short piece of wire between the ends of the link. Obviously, the short would have to be removed for 6-meter operation.

Closing remarks

With appropriate modifications these techniques should apply to most of the older VHF rigs, like the Johnson Viking 6N2.

My resurrected Seneca (shown in **photo A**) has been in daily use for 4 years with excellent performance. The only difficulty has been in training the local gang to wait for the tubes to warm up after calling me on simplex. This minor problem has been more than offset by my being (perhaps) the only person on 2-meter FM with a pair of 6146s!

Article A **HAM RADIO**

THE WEEKENDER

Solo-16 Acoustic CW speaker

When operating CW, I find even high-quality headphones become uncomfortable at times. They also accentuate wideband receiver noise — a prime source of operator fatigue. To get a break from this, I decided to make a speaker especially designed for CW reception. I first tried the familiar trick of mounting a small transistor radio speaker on the end of a toilet paper roll. This "resonant tube" approach provided some acoustic selectivity, but I decided to explore the concept a bit further.

Design

While looking through catalogs, I came upon a Star Micronics ultraminiature 20-mm speaker that specified a free-air resonance (F_S) of 700 Hz. I reasoned that coupling this particular driver to a horn-type enclosure with a corresponding resonance (F_C) of 700 Hz should result in a very high Q (frequency selective) speaker. After ordering a sample of the Star Micronics driver, I began the search for an inexpensive household item to serve as my horn. One of the first items I tested was a Solo® 16-ounce disposable plastic drinking cup. As luck would have it, this proved to be self-resonant to within 10 Hz of 700 Hz!

Construction and performance

When my sample arrived from Star Micronics, I carefully cut a hole in the bottom of the Solo cup and mounted the tiny driver in place with a super-glue adhesive. I then wired on a speaker cable and plug, and patched it into my homebrew QRP rig. (See **fig. 1**.) Listening to a busy 20-meter band, I observed that

By Rick Littlefield, K1BQT, Box 114, Barrington, New Hampshire 03825

Cards and plaque courtesy W6TC

EIMAC's new DX champion! The 3CX800A7.

Varian EIMAC continues to commit its development of reliable tubes for HAM radio.

The new, rugged 3CX800A7 power triode provides 2 kW PEP input for voice service or 1 kW cw rating up to 30 MHz. Two tubes will meet the new, higher power ratings authorized by the FCC.

Designed for today's low profile, compact linear amplifiers, the 3CX800A7 powerhouse is only 2½ inches (6.35 cm) high. Cooling requirements are modest and a matching socket, air chimney and anode clamp are available.

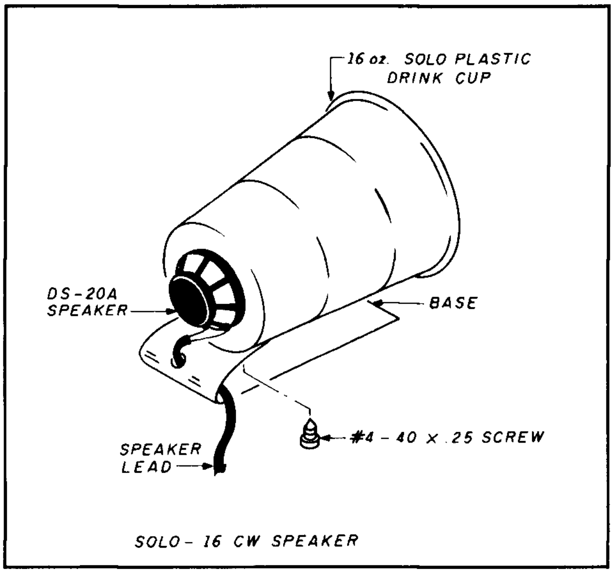
A data sheet and more information is available from Varian EIMAC. Or the nearest Electron Device Group sales office. Call or write today.

Varian EIMAC
301 Industrial Way
San Carlos, California 94270
Telephone: 415•592-1221

Eimac®

✓ 163

FIGURE 1

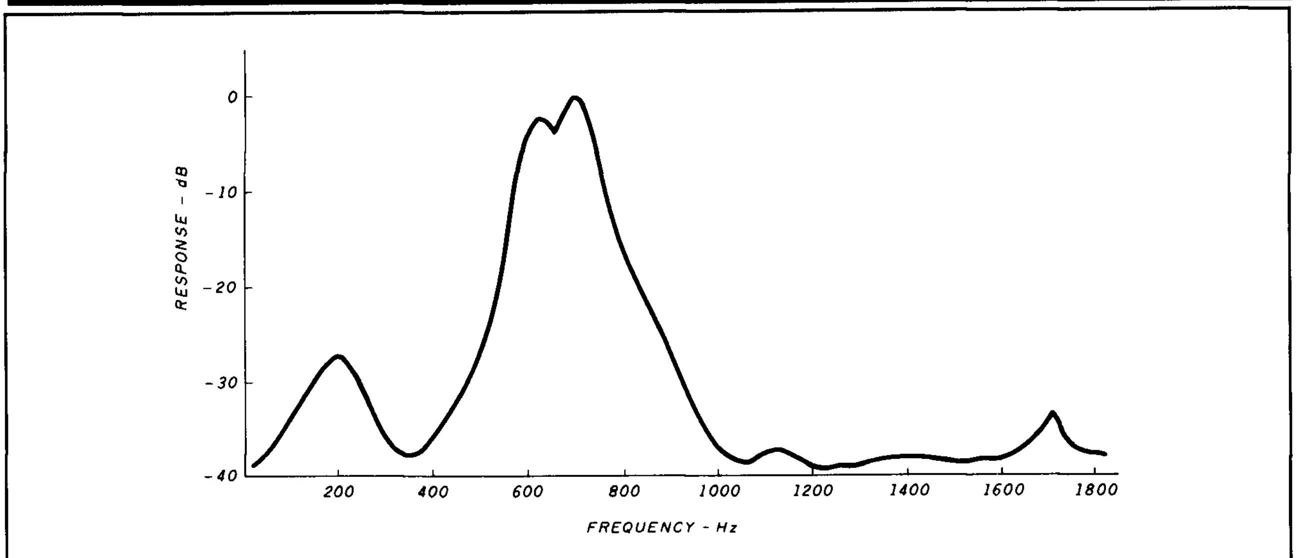


Construction details of the Solo-16 CW speaker.

There's only one precaution. While most commercial transceivers can deliver up to 5 watts of audio, the Star Micronics driver is only rated for 100-mW continuous tone (200 mW peak). To prevent driver damage, I suggest plugging into the transceiver phone jack (which is usually attenuated), or making an attenuator pad from fixed resistors. Don't worry about 100 mW being loud enough — the resonance and directivity (gain) of the horn will more than make up for any power reduction!

To complete my speaker, I made a triangular base from 1/32-inch aluminum, and attached the cup with no. 4-40 hardware. The acoustic dispersion pattern of the Solo-16 is quite directional, so I suggest adjusting your base to angle the horn directly toward your favorite operating position. This will provide the best audio path, and greatly reduce the annoying effects of phase distortion caused by room echo.

FIGURE 2



Audio frequency response of the Solo-16 CW speaker.

wideband noise had become virtually inaudible, while selectivity seemed dramatically improved. Signals were also a lot louder than through the transceiver's built-in 2-inch speaker.

To get a more quantitative measure of what I was hearing, I connected an HP-3311A function generator to the speaker leads and positioned a Scott 451 sound-level meter 1 foot from the horn opening. **Figure 2** illustrates the resulting response curve. The −3 dB passband was approximately 150 Hz wide, with response dropping very sharply on both sides to nearly −40 dB. Most transceivers — especially those without dedicated CW filters — could really benefit from these numbers!

Conclusion

Over the past two months, the Solo-16 has proven to be a great accessory for CW reception. It takes the pressure off tired ears, puts a "final filter" on audio amplifier noise, and significantly improves the selectivity of most rigs. Best of all, the Solo-16 is simple, inexpensive, and incredibly easy to make. Give it a try!

Both the speaker driver ($3.50 plus $2.00 shipping and handling) and the complete kit ($10.00 plus $2.00 shipping and handling) are available from the author. *Ed.*

Article B **HAM RADIO**

BEST OF MFJ

MFJ, Bencher and Curtis team up to bring you America's most popular keyer in a compact package for smooth easy CW

MFJ-422B

$129.95

The best of all CW worlds - a deluxe MFJ Keyer using a Curtis 8044ABM chip in a compact package that fits right on the Bencher iambic paddle!

This MFJ Keyer is small in size but big in features. You get iambic keying, adjustable weight and tone and front panel volume and speed controls (8-50 WPM), dot-dash memories, speaker, sidetone and push button selection of automatic or semi-automatic/tune modes. It's also totally RF proof and has ultra-reliable solid state outputs that key both tube and solid state rigs. Use 9 V battery or 110 VAC with MFJ-1305, $9.95.

The keyer mounts on a Bencher paddle to form a small (4 1/8 x 2 5/8 x 5½ inches) attractive combination that is a pleasure to look at and use.

America's favorite paddle, the Bench, has adjustable gold-plated silver contacts, lucite paddles, chrome plated brass, and a heavy steel base with non-skid feet.

You can buy just the keyer assembly, MFJ-422BX, for only $79.95 to mount on **your** Bencher paddle.

Artificial RF Ground

MFJ-931 **$79.95**

You can create an artificial RF ground and eliminate RF "bites", feedback, TVI and RFI when you let the MFJ-931 resonate a random length of wire and turn it into a tuned counterpoise. MFJ-931 also lets you electrically **place a far away RF ground directly at your rig** - no matter how far away it is -by tuning out the reactance of your ground connection wire. 7½x3½x7 in.

Antenna Bridge

MFJ-204B **$79.95**

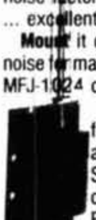
Now you can quickly optimize your antenna for peak performance with this portable, totally self-contained antenna bridge.

No other equipment needed - take it to your antenna site. Determine if your antenna is too long or too short, measure its resonant frequency and antenna resistance to 500 ohms. It's the easiest, most convenient way to determine antenna performance. Built-in resistance bridge, null meter, tunable oscillator-driver (1.8-30 MHz). Use 9 V battery or 110 VAC with AC adapter, $9.95.

Super Active Antenna

'World Radio TV Handbook' says MFJ-1024 is "a first rate easy-to-operate active antenna ... quiet ... excellent dynamic range ... good gain ... very low noise factor... broad frequency coverage ... excellent choice."

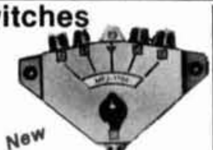
Mount it outdoors away from electrical noise for maximum signal, minimum noise. MFJ-1024 covers 50 KHz to 30 MHz



Receives strong, clear signals from all over the world. 20 dB attenuator, gain control. ON LED Switch two receivers and aux. or active antenna. 6x23x5 in. Remote unit has 54 inch whip, 50 ft. coax and connector. 3x2x4 in. 12 VDC or 110 VAC with MFJ-1312, $9.95.

MFJ-1024 **$129.95**

MFJ Coax Antenna Switches



$34.95 MFJ-1701 **$21.95** MFJ-1702 New **$59.95** MFJ-1704

Select any of several antennas from your operating desk with these MFJ Coax Switches. They feature mounting holes and automatic grounding of unused terminals. They come with MFJ's one year **unconditional** guarantee.

MFJ-1701, $34.95. Six position antenna switch. SO-239 connectors. 50-75 ohm loads. 2 KW PEP, 1 KW CW. Black aluminum 10x3x1½ inch cabinet.

MFJ-1702, $21.95. 2 positions. Cavity construction. 2.5 KW PEP, 1 KW CW. Insertion loss below .2 dB. 50 dB isolation at 450 MHz. 50 ohm. 3x2x2 in.

MFJ-1704, $59.95. 4 position Cavity Switch with Lightening/Surge protection device. Center Ground position. 2.5 KW PEP, 1 KW CW. Extremely low SWR. Isolation better than 50 dB 500 MHz. Negligible loss. 50 ohm. 6¼x4¼x1¼ in.

"Dry" Dummy Loads for HF/VHF/UHF

MFJ-260 **$28.95** MFJ-262 **$69.95** New MFJ-264 **$109.95**

MFJ has a full line of dummy loads to suit your needs. Use a dummy load for tuning to reduce needless (and illegal) QRM and save your finals.

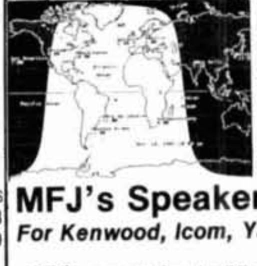
MFJ-260, $28.95. Air cooled, non-inductive 50 ohm resistor. SO-239 connector. Handles 300 watts. Run full load for 30 seconds, derating curve to 5 minutes. SWR less than 1.3:1 to 30 MHz, 1.5:1 30-60 MHz. 2½x2½x7 in.

MFJ-262, $69.95. Handles 1 KW. SWR less than 1.5:1 to 30 MHz. 3x3x13 in.

MFJ-264, $109.95. Versatile UHF/VHF/HF 1.5 KW Dry Dummy Load. An MFJ first. Gives you low SWR to 650 MHz, usable to 750 MHz. You can run 100 watts for 10 minutes, 1500 watts for 10 seconds. SWR is 1.1:1 to 30 MHz, below 1.3:1 to 650 MHz. 3x3x7 inches. SO-239 connector.

MFJ-1286 Gray Line DX Advantage

New **$29.95** MFJ-1286



Snag rare DX for only $29.95! The MFJ-1286 is a computerized DXing tool that predicts DX propagation. Even the casual DXer can work rare DX by knowing when conditions are best for DX. The Gray Line is the day/night divider line where the most amazing DX happens every day. Now you'll know **exactly** when to take advantage of it.

Gives detailed world map. Shows Gray Line for any date/time, UTC in 24 user chosen QTHs, time zones and more. IBM compatible. Any graphics.

MFJ's Speaker/Mics

For Kenwood, Icom, Yaesu, Santec MFJ-284 or MFJ-286 **$24.95**

MFJ's compact Speaker/Mics let you carry your HT on your belt and never have to remove it to monitor calls or talk.

You get a wide range speaker and first-rate electret mic element for superb audio on **both** transmit and receive.

Earphone jack, handy lapel/pocket clip, PTT, lightweight retractable cord. Gray. One year **unconditional** guarantee.

MFJ-284 fits Icom, Yaesu, Santec. **MFJ-286** fits Kenwood.

12/24 Hour LCD Clocks

$19.95 MFJ-108B **$9.95** MFJ-107B

Huge 5/8 inch bold LCD digits let you see the correct time from anywhere in your shack. Choose from the dual clock that has separate UTC/local time display or the single 24 hour ham clock.

Mounted in a brushed aluminum frame. Easy to set. The world's most popular ham clocks for accurate logs. MFJ-108B 4½x1x2; MFJ-107B 2¼x1x2.

Lighted Cross/Needle SWR/Wattmeter

MFJ-815 **$69.95**

MFJ Cross-Needle SWR/Wattmeter shows you SWR, forward and reflected power in 3 ranges (20/200/2000 watts forward/5/50/500 reflected). Push button range selection. 1.8-30 MHz.

Mechanical zero adjust for movement. SO-239 connectors. Light requires 12 VDC or 110 VAC with MFJ-1312, $9.95.

Deluxe Code Practice New Oscillator

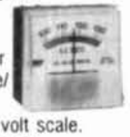
MFJ-557 **$24.95**

MFJ-557 Deluxe Code Practice Oscillator has a Morse key and oscillator unit mounted together on a heavy steel base so it stays put on your table. Also portable because it runs on a 9 volt battery (not included) or an AC adapter ($9.95) that plugs into the side.

Earphone jack for private practice. Tone and volume controls for a wide range of sound. Speaker. The key has adjustable contacts and can be hooked to your transmitter. Sturdy. 8½x2¼x3¾ in. One year **unconditional** guarantee.

MFJ AC Voltage Monitor

$19.95 MFJ-850 New



Prevent damage to rig, computer or other gear. Monitor AC line voltage for potentially damaging surge/brown out conditions on 2-color expanded 95-135 volt scale.

Plugs into any AC outlet. 2% accuracy. 2¼x2¼x1½ inches.

• One year **unconditional** guarantee • 30 day **money back** guarantee (less s/h) on orders from MFJ • Add $5.00 each s/h • **Free** catalog

MFJ

MFJ ... making quality affordable

MFJ ENTERPRISES, INC.
P.O. Box 494, Mississippi State, MS 39762
(601) 323-5869; TELEX: 534590 MFJSTKV
Nearest Dealer or Orders only: 800-647-1800

R4
Maximum Performance, Minimum Space

If you are like our friend on the island, living with limited space, R4 is for you.

That's right, you can forget about towers and rotators. Put away your spade, wire and insulators because you won't need a ground radial system. Cushcraft engineers have performed a miracle by developing a new half wave vertical for 10, 12, 15 and 20 meters that provides great performance using a simple counterpoise ground of four 48" stainless steel rods.

The new R4 has broadband impedance matching giving full coverage and automatic frequency selection of all four bands. All of this with an 18' high, 8 lb. vertical that will handle 1800 watts of power!

With R4 you get quick assembly, easy installation and top gun performance. Whatever your space, large or small, *R4 will make ham radio* more fun.

Buy R4 and talk to your friends around the world today!

cushcraft
CORPORATION

Available through dealers worldwide

48 Perimeter Road, Manchester, NH 03108 USA
603-627-7877 Telex 4949472
Fax 603-627-1764

172

HAM RADIO TECHNIQUES

Bill Orr, W6SAI

The "Invention of Radio"

The world changed for better or worse in 1865 when James Clerk Maxwell introduced his electromagnetic wave theory. This revolutionary concept fell on stony ground until 1875 when Professor Elihu Thompson demonstrated the existence of the waves in an induction coil experiment at Central High School in Philadelphia. The experiment wasn't widely publicized and Thompson doesn't seem to have carried out any further investigations. This field of discovery appears to have lain dormant until 1888 when Heinrich Hertz described his classic experiments with "aether" waves.

But it's not generally known that on May 23, 1885 Thomas A. Edison applied for a patent on "A New and Useful Improvement in Means for Transmitting Signals Electrically." Patent number 465,971 was issued to Edison on December 29, 1891.

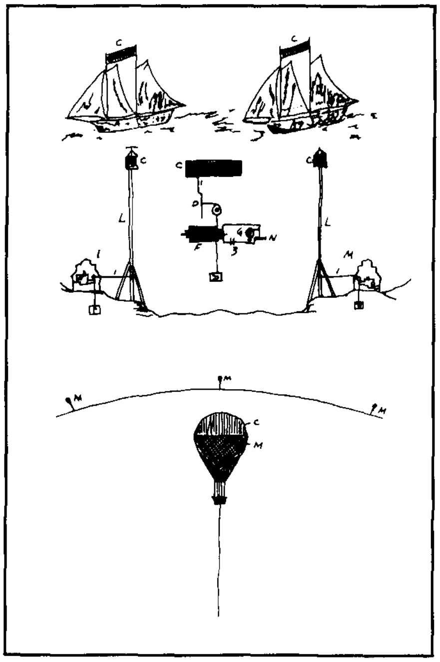
What was the meaning of this patent? Did Edison actually "invent" radio? Tom Clarkson, ZL2AZ, recently brought to my attention a story which created a ripple of excitement at the International Telecommunications Union Conference in Atlantic City, New Jersey in 1947.

Tom, who attended the conference, was kind enough to send me a reprint of the conference bulletin, *The Morning Electron*, dated September 12, 1947; it told the story of the "invention" of wireless.

According to Tom, the introductory remarks of the U.S. Assistant Secretary of State to those assembled referred to the magnitude of the task confronting the members, because of the great advances in radio communication since Marconi's invention. The next day one of the delegates of the U.S.S.R. took the floor to "correct an error." The real inventor of radio communication wasn't Marconi, he stated, but Alexander Popoff. He gave a vigorous address on the subject. A few days later an Italian delegate defended Marconi who, he said, did a lot more than just demonstrate primitive receiving and transmitting equipment.

The matter rested until a member of the U.S. Delegation produced a patent filed by Edison. It was dated ten years earlier than the experiments of either Marconi or Popoff, and two years before Hertz's work. The patent described a two-way radio communication system. A transcript of the patent was included in the *The Morning Electron*. After that, the conference dropped the subject and went on to more important matters.

FIGURE 1



Thomas Edison's "wireless" communication system (reproduced from original patent).

Edison's communication system

ZL2AZ mailed me a copy of the 1947 conference newsletter, now part the archives of the Antique Wireless Association. The Edison patent covered a signaling system that used two transceiver-like devices, complete with vertical antennas and ground systems (**fig. 1**[1]). Each transceiver had a high-frequency transformer with the secondary connected to the antenna and ground, an interrupter in the primary circuit, a source of power, and a code key. The motor-driven interrupter functioned as a commutator, generating a high-frequency wave. This device is similar to the early rotary gap-type transmitters used from 1897 to about 1910 and popularized by Poulsen of Denmark.

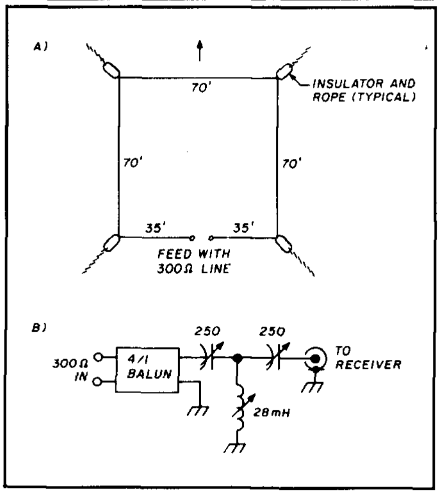
For reception, Edison placed a "polarized telephone receiver" in series with the secondary coil of the apparatus. Little is known about this device; however, it's thought to have been an ordinary telephone-style earphone in series with a crude oxide rectifier. The patent is vague on this point.

The patent shows that Edison understood the necessity of elevating his antennas to avoid the curvature of the earth. He also mentions signal absorption due to intervening objects.

The newsletter concluded that Edison had a clear concept of a workable radio system, and that he had foreseen many of the ideas that have taken years to perfect.

I find it interesting to speculate on this unusual patent. Why did it lie in the Patent Office for over six years before it was issued? Why didn't Edison build a working model of his transceiver and try out his novel idea? It's conceivable that Edison could have had a practical wireless system in 1885 — two years before Hertz's experiments. Because Edison chose not to continue with his brilliant idea, the honor of conducting the first radio communication experiments passed to Marconi, who started his transmissions in 1894.

FIGURE 2



Receiving loop of KDØSO for 160 meters. Height of loop above ground is 10 feet. Illustration (A) is view from above. Illustration (B) shows 4:1 balun and antenna tuner.

The low-level loop for reception

One of the problems in working DX on 160 meters is the high level of background noise. Many DXers have found they can't use their transmitting antenna for reception — the noise level is overpowering. Paul McClure, KDØSO, met this problem head on and evolved a horizontal receiving loop (**fig. 2**) that provides good signal-to-noise ratio. The loop's signal pickup isn't as good as that of a larger antenna, but noise drops off sharply. By adjusting audio gain of the receiver, you can bring the resulting signal up to the original level. Paul says that, out of the noise, he can pull weak signals that didn't seem to exist under normal circumstances. He says the antenna is comparable to a good Beverage wire. The loop, however, takes up less space and there are no terminating resistors to replace after a thunderstorm!

The above-ground height of the loop is about 10 feet. It's fed with a random length of 300-ohm ribbon line. Paul twists the line to balance it to ground. He has a twist about every 8 inches or so in a line nearly 100 feet long. The line is fed through a 4:1 balun and a simple antenna tuner to provide a 50-ohm termination for the receiver.

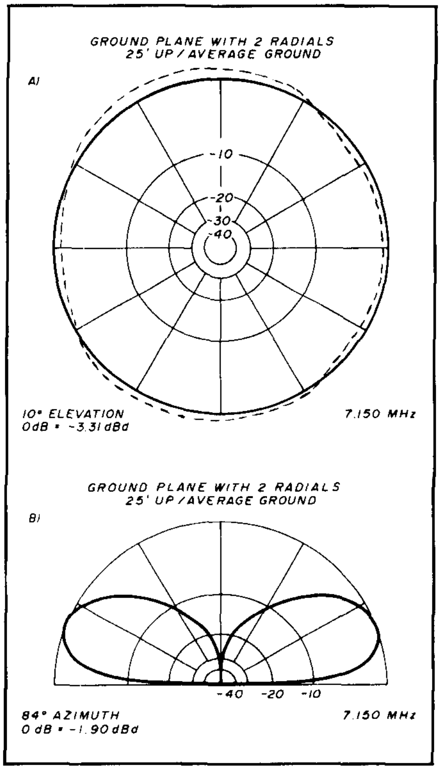
Two radials good, four radials better?

I seem to have stirred up some dust with my remarks about two versus four radials for a ground-plane antenna (*Ham Radio*, October 1988). A letter from Don Norman, AF8B, says that experiments he ran in 1982 on an elevated 147-MHz ground plane showed two radials were a considerable improvement over one, three radials showed no improvement over two, and four showed a slight improvement over three. He said his tests also showed conclusively that the radials served to decouple the feedline from the antenna.

Don's opinion is that HF multiband verticals planted in back yards around the world would probably perform much better if they were placed on rooftops and equipped with two radials for each band.

Bill Bringler, K5CSJ, ran the

FIGURE 3



Plane and elevation views of radiation pattern of 2-radial ground plane mounted 25 feet above "average" ground.

America's Communications Leader Presents Its All-New 10-Meter SSB/CW Mobile Transceiver

Realistic, America's premier brand of scanners, CB radios and satellite TV systems introduces the HTX-100, the perfect first rig for a beginning Ham and a superb 10-meter mobile radio for any amateur. It's compact, yet loaded with "big rig" features.

Pushbutton Memory Tuning

An easy-to-program memory stores 10 favorite frequencies and mike-mounted pushbuttons permit safe and easy up/down frequency selection while you drive. A front-panel lock control prevents accidental frequency changes. You can fine-tune reception with the ±1.5 kHz RIT control. Coverage is 28.0 to 29.6999 MHz, USB or CW. Convenient semi break-in keying and CW sidetone are built in.

Ultracompact and includes everything you need for underdash installation

Selectable Power Output

You can select 25-watt or 5-watt QRP power output from the front panel. The HTX-100 has a backlit LCD frequency display with mode and tuning-step indicators. You also get a 5-step LED signal/RF power meter, noise blanker, hefty 3-watt audio output, high-quality built-in speaker, front-panel headphone jack and a rear-panel jack for adding an external speaker.

Join the Action on "10"

With improving band conditions and new Novice voice and digital privileges, the 10-meter fun is just beginning. Be a part of it with this affordable, top-quality transceiver! Only $259.95 and in stock today at our store near you.

Exclusively at

Radio Shack
The Technology Store™

A DIVISION OF TANDY CORPORATION

Price applies at participating Radio Shack stores and dealers

FREE 184-Page Radio Shack Catalog! Write Dept. 380, 300 One Tandy Center, Fort Worth, TX 76102 ground-plane program on his computer using MININEC and compared the field patterns of two and four-element configurations. The simulation was at 7.15 MHz, with the base of the antenna 25 feet above "average" ground (**fig. 3**). The radials dropped down to 15 feet of elevation at the ends. At a radiation angle of 10 degrees, the pattern of the two-radial design was omnidirectional within a fraction of a decibel. In the vertical plane, the angle above the horizon of the radiation pattern was less than 20 degrees. This corresponded to the pattern of the four-radial design. Bill concluded that there was no significant difference in operation between the two antennas. Bill also compared a ground-mounted vertical against the elevated two-radial design and found it about 1.5 dB worse at an elevation angle of 10 degrees. His conclusion: "A two-radial ground plane, when elevated, works just fine!"

And how about radial length?

Collin Stiteler, KE6VZ, isn't convinced that ground-plane radials should be 5 percent longer than the radiator, as some conventional wisdom seems to indicate. I checked my references and found that my various antenna books, plus the *ARRL Radio Handbook*, all call for the radial length to be the same as the antenna length. (At least I seem to be consistent!) Different ARRL publications refer to radials 5 percent longer than the antenna and also to radials the same length as the antenna, depending upon the publication. Obviously there's *not* a meeting of the minds on this subject. Offhand, I would think that it doesn't make any difference as far as results are concerned. I cut my radials equal in length to the antenna and let it go at that.

Collin points out that a CB whip antenna mounted over quarter-wave horizontal 10-meter radials and matched with a capacitor across the feedpoint makes an excellent 10-meter installation with a near-perfect match to a 50-ohm coax line. Collin used a 56-pF capacitor from antenna to radials. Not a bad idea for a "quick and dirty" 10-meter antenna.

Two new handbooks!

I've just received two new handbooks that I'd like to tell you about. The first one is *W1FB's Antenna Notebook*,* written by Doug DeMaw and published by the ARRL. This book covers many simple do-it-yourself antennas. There's no high-level math in the book; it's a plain language approach to a subject that's of great interest to newcomers and old-timers alike.

DeMaw discusses many interesting wire antennas like the popular G5RV antenna, multiband dipoles, and trap dipoles. Single wire, loops, and vertical antennas are covered in detail. The scheme of using a tower or mast for a vertical antenna is discussed, along with the tuning and matching procedures required. The efficient W1FB compact 160-meter vertical antenna seems to be the answer for the low-band DXer trying to be loud when confined to a city lot! The 160-meter "snake" antenna (of which I had heard rumors) is shown as well as other low-noise receiving antennas for the top band.

Antenna matching devices and baluns are discussed, as are simple antenna measuring techniques, but the Amateur looking for VHF antenna information will be disappointed. The book is like a low-pass filter — it cuts off at 30 MHz! No matter; there's enough juicy information about 1.8 to 30 MHz to maintain your interest to the last page.

The second book resembles a high-pass filter, as it concentrates on the spectrum above 50 MHz. This is my new book, *All About VHF Amateur Radio*, published by Radio Publications, Inc.** It's written for the beginning Amateur and the newcomer to the VHF bands. However, there's enough good information on VHF antennas, the cause and cure of VHF RFI and TVI, moonbounce, satellites, and DX propagation to interest even the jaded VHF old-timer. Modesty prevents me from extolling the virtues of the work, but I wanted to bring it to your attention!

The F.C.C. did me in on one matter. Just after the book came off the press, my reference to the 220 and 225-MHz Amateur band was jeopardized because of the attempted usurpation of the low end of the band. I hope, for my sake and for the sake of Amateur Radio, that I won't have to change this reference at the next reprinting!

A final wrap-up

Thanks to all who have entered my "Dead Band" Quiz. Closing out the *earlier quizzes: congratulations to* Dan Curtin, KF4AV, who correctly identified the Sherlock Holmes quotation, and to Lewis Finch, W4VRV; Marty Davidoff, K2UBC; Bruce Williams, WA6IVC; Alvin Borne, W6IVO; Dan Curtin, KF4AV; and "Herb", WL7BIL who knew the quotation from "Catcher In The Rye," by J.D. Salinger.

Occam's Razor, locomotives, and hornets

Early in the 14th century, the English philosopher William of Occam proposed that, of all the possible explanations for certain phenomena, the simplest explanation should be considered first. A fine example of Occam's Razor (cut the problem to the bone) was the Dead Band Quiz about the colliding locomotives and the flying hornet.

The correct answer regarding the distance the hornet flew between the locomotives as they sped towards each other on a collision course is 300 miles. A lot of readers came up with this number.

It's interesting to look over the many replies I received to this little problem. In general, there were four approaches: the intuitive, the graphical, the mathematical, and the scientific. Some readers solved the problem in more than one way.

*Available from the **HAM RADIO** Bookstore for $7.95, plus $3.50 shipping and handling.

Available from the **HAM RADIO Bookstore for $11.95, plus $3.50 shipping and handling.

The majority of readers chose the mathematical approach, i.e., finding the time to collision by dividing the travel distance by the closing speed (60/80 = 0.75 hours). If the hornet flies at 400 miles per hour for 0.75 hour, he covers 300 miles.

A list of all who solved the "Dead Band" problem is available from *Ham Radio* for an SASE. (The list includes only those whose letters were received in the first 10 days after magazine publication. I'll pick up later entries in my next column.)

I think this magazine is fortunate to have readers of stature and I'm pleased to receive such interesting and informative "feedback." Thank you! I'll continue to toss some little brain teasers at you from time to time. I hope you enjoy them!

The Dead Band Quiz

Since everyone did so well on the locomotive/hornet quiz, here are two simple problems submitted by column readers. Sharpen your pencils and go to work!

Quiz no. 1 was submitted by Joe Mehaffey, K4IHP. A black box has five terminals. Measured with an ohmmeter, the resistance between any two terminals is 1 ohm. Joe knows the box contains only resistors. What is the circuit inside the box?

Quiz no. 2 was submitted by Joe Caffrey, W3DZH. A ham has a glass jar filled with transistors in his junkbox. He decides to count them and finds that if he removes them from the jar two at a time, he has one transistor left in the jar when he's finished. Unfortunately he forgets his count, so he dumps the devices all back into the jar. This time he removes them three at a time and winds up with two left over. Distracted by a VHF opening, he again forgets his count, replaces the transistors in the jar, and removes them four at a time to discover at the end he has three left in the jar. This process is repeated three more times. When he removes them five at a time, he finds four left over; when they are taken out six at a time, five are left; and when taken out in groups of seven, six remain.

Having managed to forget the exact count six times now, our hero decides to apply simple mathematics to find the smallest number of transistors that could have been in the jar. What is that number?

Joe says, "My initial solution involved 'cheating' by programming a VIC-20 computer to count upwards from 11 and test each integer until one was found that would satisfy the given conditions. Hours later, the simple and elegant solution struck me as I was driving down the road in my car!"

To save your postage and time, I'll give the answer to these little problems next month. Stay tuned.

References

1. *The Morning Electron*, Volume One, No. 67, International Telecommunications Union Conference, September 12, 1947, page 7.

Article C **HAM RADIO**


HITACHI SCOPES AT DISCOUNT PRICES
V-212
$399
List $560
Save $161
20MHz Dual Trace Oscilloscope
All Hitachi scopes include probes, schematics and Hitachi's 3 year guaranty on parts and labor. Many accessories available for all scopes.
• DC to 40MHz
• Dual Channel
• CRT Readout
• Cursor Meas
• DC Offset
• Alt Magnifier
• Compact Size
V-425
List $995
$835
• DC to 100MHz
• Dual Channel
• Delayed Sweep
• CRT Readout
• Sweep Time
• Autoranging
• Trigger Lock
• 2mV Sensitivity
V-1060
List $1595
$1,285
LIST PRICE SAVE
V-223 20MHz D.T., 1mV sens, Delayed Sweep, DC Offset, Vert Mode Trigger $770 $695 $75
V-422 40MHz D.T., 1mV sens, DC Offset Vert Mode Trigger, Alt Mag $875 $695 $180
V-423 40MHz D.T., 1mV sens, Delayed Sweep, DC Offset, Alt Mag $955 $795 $160
V-660 60MHz D.T., 2mV sens, Delayed Sweep, CRT Readout $1,195 $990 $205
V-1065 100MHz D.T., 2mV sens, Delayed Sweep, CRT Readout, Cursor Meas $1,895 $1,670 $225
V-1100A 100MHz Q.T., 1mV sens, Delayed Sweep, CRT Readout, DVM, Counter $2,295 $1,995 $300
V-1150 150MHz Q.T., 1mV sens, Delayed Sweep, Cursor Meas, DVM, Counter $3,100 $2,565 $535
ELENCO PRODUCTS AT DISCOUNT PRICES
20MHz Dual Trace Oscilloscope
$359
MO-1251
• 6" CRT
• Built in component tester
• TV Sync X-Y Operation
FREE DMM
with purchase of
MO-1251/1252 Scope
SCOPE PROBES
P-1 65MHz, 1x, 10x $19.95
P-2 100MHz, 1x, 10x $23.95
Fits all scopes with BNC connector
35MHz Dual Trace Good to 50MHz
$495
MO-1252
• High luminance 6" CRT
• 1mV Sensitivity
• 6KV Acceleration Voltage
• 10ns Rise Time
• X-Y Operation • Z Axis
• Delayed Triggering Sweep
Top quality scopes at a very reasonable price. Contains all desired features. Two 1x, 10x probes, diagrams and manual. Two year guarantee.
Autoranging DMM
M-5000
$45
9 Functions
Memory and Data hold
½% basic acc
3½ digit LCD
True RMS 4½ Digit Multimeter
M-7000
$135
.05% DC Accuracy
.1% Resistance
with Freq. Counter
and deluxe case
Multimeter with Capacitance and Transistor Tester
$55 CM-1500
Reads Volts, Ohms, Current, Capacitors, Transistors and Diodes with case
Digital Capacitance Meter
CM-1550
$58.95
9 Ranges
.1pf-20,000ufd
.5% basic accy
Zero control
with case
Digital LCR Meter
LC-1801
$125
Measures
Coils 1uH-200H
Caps .1pf-200uf
Res .01-20M
AC Clamp-On Current Adapter
ST-265
$22
0-1000A AC
Works with most DMM
Bench DMMS
M-3500
3½ digit .1% accy
$125
M-4500
4½ digit .05% accy
$175
SOLDERING STATION TEMPERATURE CONTROLLED
SL-30
$135
Digital display
Temp range: 300F-900F
Grounded tip
Overheat prot
Solderless Breadboards
9430
1,100 pins $15
9434
2,170 pins $25
9436
2,860 pins $35
All have color coded posts
9436 SHOWN
Low Cost Multimeter
M-1600
$25
3½ digit LCD
1% DC Accy
10A Scale
Auto zero
/polarity
Wide Band Signal Generators
SG-9000 $129
RF Freq 100K-450MHz
AM Modulation of 1KHz
Variable RF output
SG-9500 with Digital Display and 150MHz built-in Freq Ctr $249
3½ Digit Probe Type DMM
M-1900
$39
Convenient one hand operation
Measures DCV, ACV, Ohms
Audible continuity check, Data hold
with batteries and case
Function Generator Blox
#9600
$28.95
Provides sine,tri,squ wave
From 1Hz to 1MHz
AM or FM capability
Decade Blox
9610 or 9620
$18.95
#9610 Resistor Blox
47 ohm to 1M & 100K pot
#9620 Capacitor Blox
47pf to 10MFD
Digital Triple Power Supply
XP-765
$249
0-20V at 1A
0-20V at 1A
5V at 5A
Fully Regulated, Short circuit protected with 2 Limit Cont., 3 Separate supplies
XP-660 with Analog Meters $175
Quad Power Supply
XP-580
$59.95
2-20V at 2A
12V at 1A
5V at 3A
-5V at 5A
Fully regulated and short circuit protected
XP-575 without meters $39.95
10MHz XT 100% IBM® Compatible
5 Year Warranty
$595
MODEL PC-1000
•5/10MHz Motherboard
•8 Expansion Slots
•Math Compressor Slots
•360K Floppy Drive
•AT Style Keyboard
•150W Power Supply
•256K RAM Expandable to 640K
•Monochrome Monitor
•Monographic Video Card
•Parellel Printer Port
FREE spreadsheet and word processor
3.XXMS DOS and GW Basic add $75
Four-Function Frequency Counters
F-1000 1.2GH
$259
F-100 120MH
$179
Frequency, Period, Totalize, Self Check with High Stabilized Crystal Oven Oscillator, 8 digit LED display
GF-8016 Function Generator with Freq. Counter
$239
Sine, Square, Triangle
Pulse, Ramp, .2 to 2MHz
Freq Counter .1 - 10MHz
GF-8015 without Freq. Meter $179
WE WILL NOT BE UNDERSOLD!
UPS Shipping: US 5%
($10 Max) IL Res., 7% Tax
VISA MasterCard
C & S SALES INC.
1245 Rosewood, Deerfield, IL 60015
(800) 292-7711 (312) 541-0710
15 Day Money Back Guarantee
2 Year Warranty
WRITE FOR FREE CATALOG

✓ 118

Station Control Node
EXPAND YOUR VERSATILITY WITH THE SCN

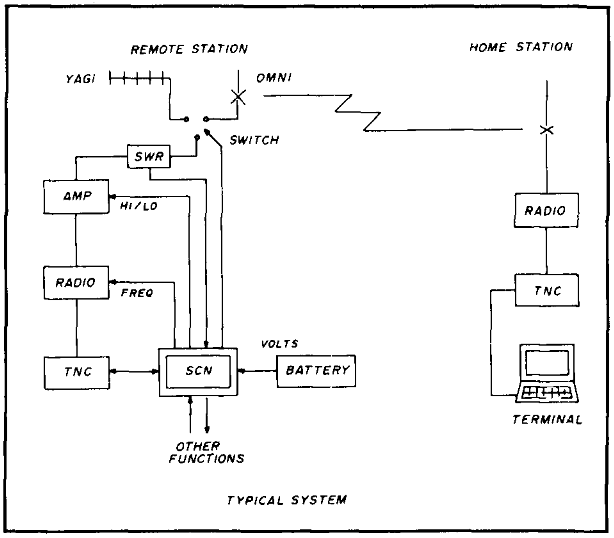
By Barry Buelow, WA0RJT, 4110 Emerson Avenue, N.E., Cedar Rapids, Iowa 52402

Now you can use a terminal, computer, or even a mailbox to monitor and control your equipment with this packet radio Station Control Node (SCN). Packet radio provides a reliable link and the SCN controls the equipment. You can stay at home and use packet to find out what's going on up on the mountain or out among the corn stalks. Nearly any task you can do manually, you can now do remotely.

Figure 1 shows a typical SCN installation. You establish a connection with the remote TNC and automatically access the SCN. Designed to operate at unattended sites, the SCN lets you monitor door switches, tower lights, AC line status, temperature, RF power, SWR, or battery voltage. It lets you control antenna selection, frequency, power amplifier operation, and other functions. The Station Control Node is a data acquisition and control system that works in conjunction with a packet radio Terminal Node Controller (TNC). An SCN consists of a microcomputer and a variety of I/O buffers that you can access via packet.

Many SCN components incorporate high levels of integration to perform sophisticated functions. This lowers the parts count, reduces board size, and eases system startup.

FIGURE 1



Typical system.

Hardware description

The system's design is straightforward. Functional segregation facilitates trouble-shooting, should it be necessary. The components mount on two printed circuit boards. The main computer circuits are on one card and all the applications you want to control will connect to the buffer card.

MCU card

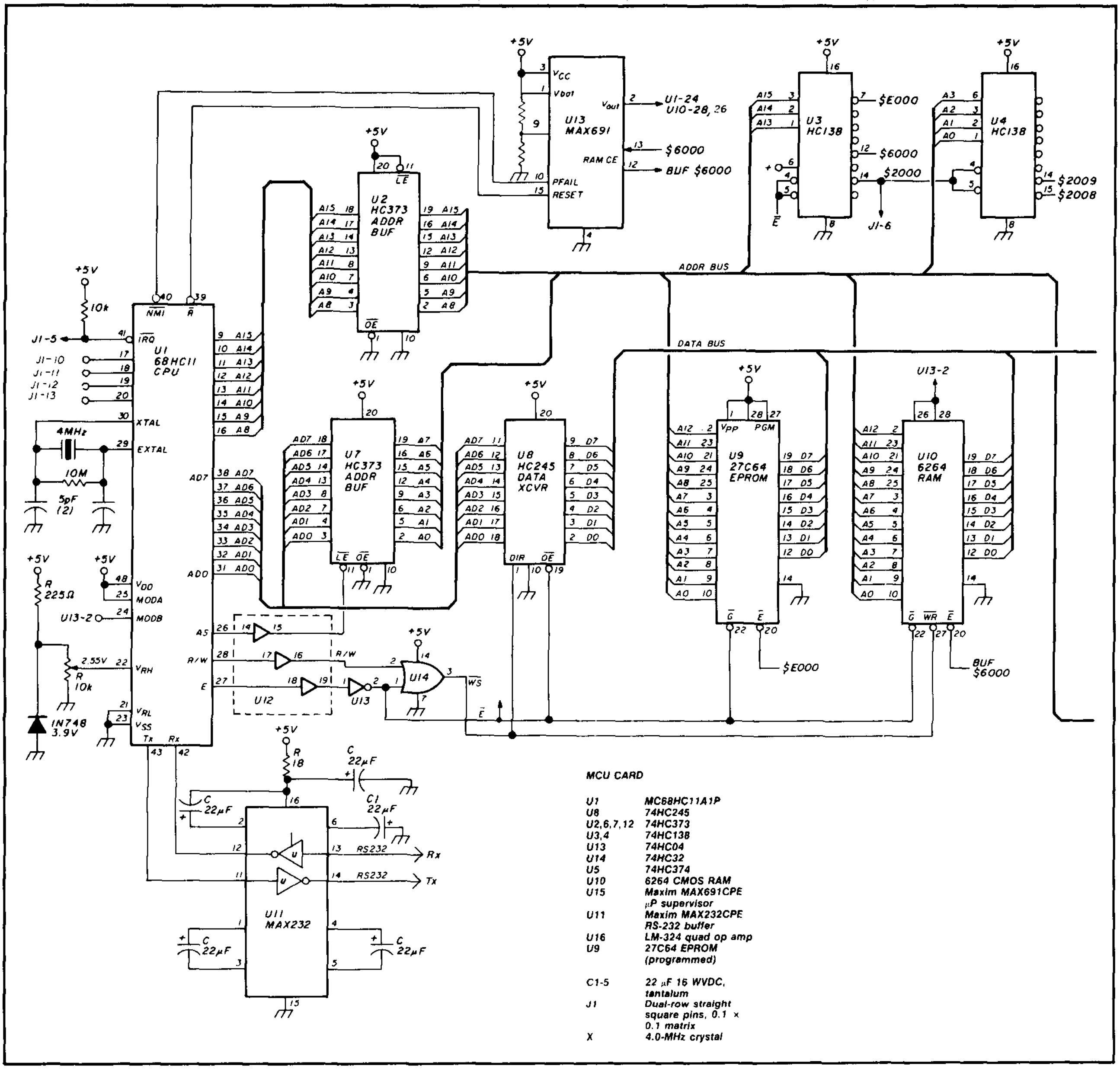
All of the digital ICs are low power CMOS, including the MC68HC11 processor. Motorola did a good job of incorporating desirable features in this single-chip microcomputer (MCU). It contains the CPU, 256 bytes of RAM, 512 bytes of EEPROM, serial port, A/D converter, timers, and more. (These functions used to require a large amount of board space.) A single crystal, which is a multiple of the baud rate, serves as a clock for both the MCU and the internal serial port clock.

Operating in the expanded mode, the MCU configures the ports as an external data and address bus. These buses access the EPROM and hardware ports.

The MCU assembly consists of the MC68HC11, a 27C64 EPROM, buffers, address decoding, and two ports. A DIP switch identifies the type of TNC and selects the setup mode. A 7-segment LED display traces the software activity for debugging purposes. To provide for some expansion, a socket is available for a 6264 CMOS RAM (8K × 8). However, the current version of software doesn't require external RAM.

A Maxim MAX232 serves as the RS-232 interface.

FIGURE 2



MCU card schematic. (All unused inputs of U12, U13, and U14 should be tied to ground.)

This chip uses only +5 Vdc and generates ±10 Vdc by a series of choppers and external tantalum capacitors. The line drivers and receivers then operate at the proper ±10 volt levels.

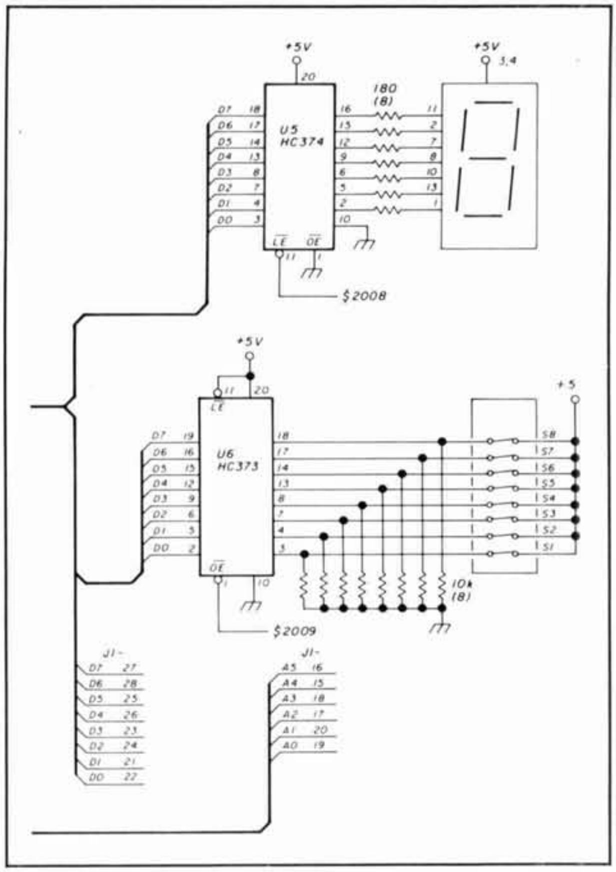
Another Maxim part, the MAX691, monitors the +5 Vdc line. In the event of a power failure or brownout, the chip will signal the MCU to halt operation. This prevents erroneous operation during power up/down which might corrupt the RAM data. The chip also switches the optional backup battery to the MODB line of the MCU, maintaining RAM data. (See **fig. 2** for a complete schematic.)

Buffer card

A single external power supply of at least 8 volts AC or DC will operate the entire unit. The SCN requires about 200 mA. You can use a modular AC line adapter or power the unit from a 12-Vdc source.

There are two ports (8 bits each) with buffers for discrete inputs. A network clamps the input to the CMOS logic levels and provides protection from lightning-induced spikes. Applying a voltage of +5 Vdc or more will provide a logic 1 to the MCU. A low logic level results from either applying a ground

FIGURE 2



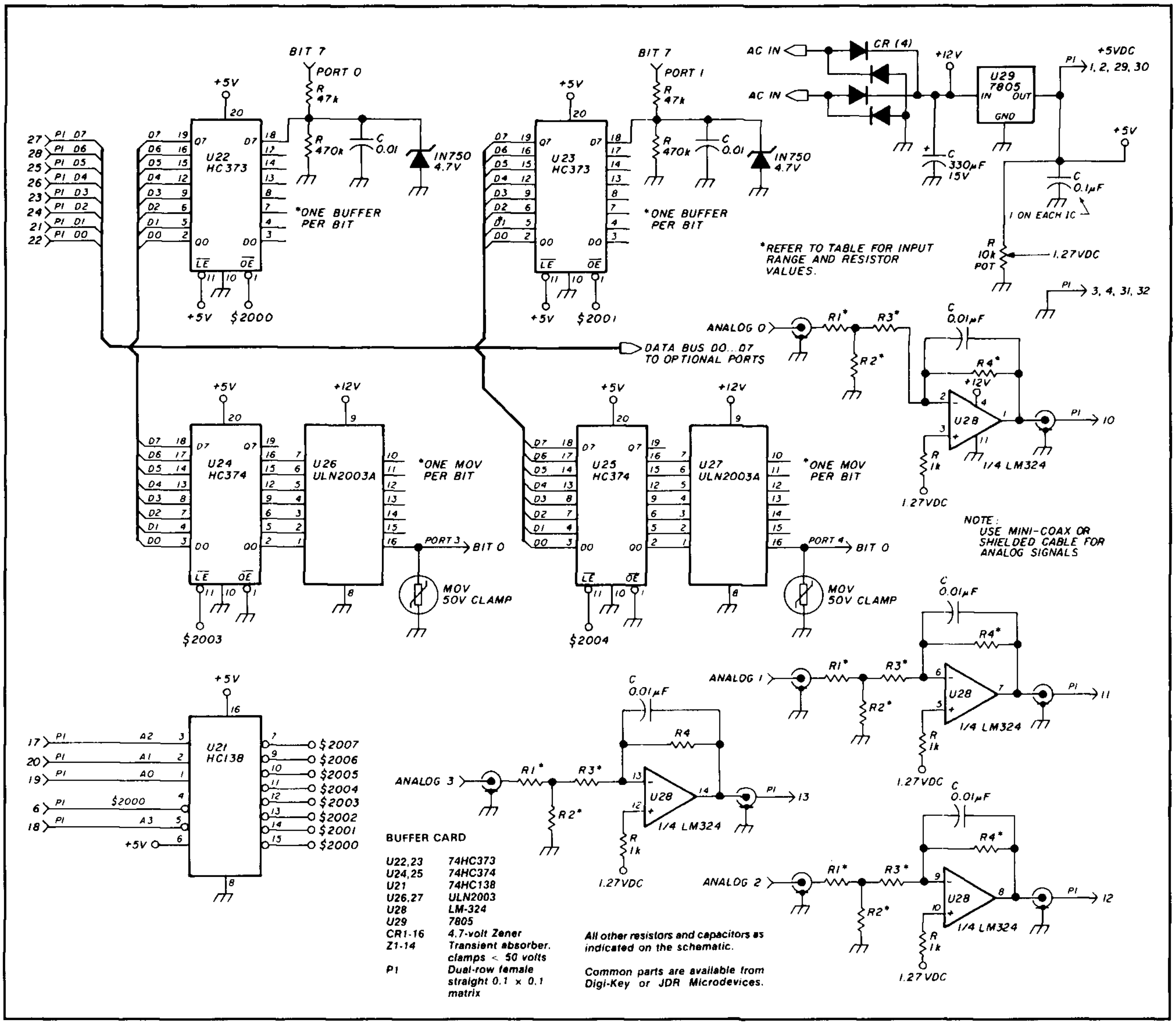
or leaving the input open. This allows you to connect directly to signals operating over the range of + 12 Vdc to ground. The SCN provides two ports with output drivers (7 bits each). A 74HC374 latches the data and drives a ULN 2003A which contains 7 Darlington pairs. These outputs are either open or sink current to ground. Note the logic here. When you set a bit, the SCN enables the driver which provides a ground, turning on the external device. At power up, all drivers are commanded to a logic 0. You can wire the two uncommitted bits to any unique drivers you wish to build.

Two additional ports can be installed with either 74HC373s or 74HC374s. The board location configures the port as either an input or output. You can build whatever interface you desire on these ports.

There are four analog inputs which have individual buffers and scaling. The inputs are single ended and feed into an LM-324 quad op amp. A voltage divider precedes the op amp for input voltages greater than + 5 Vdc. You can use the high range to monitor a battery; the low range is suitable for monitoring SWR or forward power. The maxim .n input voltage translates to zero volts out and zero volts in becomes + 2.55 volts out.

If the input is greater than + 2.55 volts, the voltage

FIGURE 3



Buffer card schematic.

divider must reduce the signal. In **Table 3**, the +15 volt signal is divided down to +2.55 volts using a divider current of 1mA. The buffer gain is −1 and the software inverts the signal again.

Figure 3 shows a complete schematic.

Software

The software has a good mix of user-accessible functions and self-maintenance tasks. These should take care of most of your remote control needs and eliminate a few trips to the mountain top.

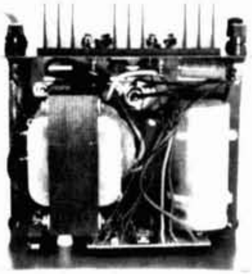
Many program functions aren't visible, but are essential to SCN operation.

- Every 31 mS, the MC68HC11 internal hardware generates an interrupt which triggers the background task.
- Software timers monitor user activity and reset the heartbeat monitor periodically.
- A foreground routine monitors flags set by the various interrupts and transfers control to the proper servicing task. Limiting the number of tasks helps fit all of the operation into the 256 bytes of RAM, so only one task is active at a time.

Foreground tasks perform these functions: user sign-on message and menu, long/short menu, recognition of one-character commands, traps for illegal commands, and a long delay on power up so the TNC can recover first.

The program measures the analog inputs with each program cycle. Depending on the state of the PTT line, the A/D values are stored in RAM as TX or RX data.

ASTRON CORPORATION
9 Autry
Irvine, CA 92718
(714) 458-7277



INSIDE VIEW — RS-12A

ASTRON POWER SUPPLIES

• HEAVY DUTY • HIGH QUALITY • RUGGED • RELIABLE •

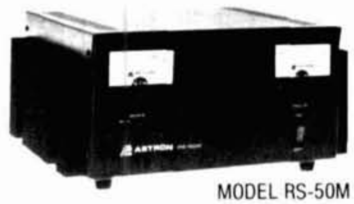
SPECIAL FEATURES

- SOLID STATE ELECTRONICALLY REGULATED
- FOLD-BACK CURRENT LIMITING Protects Power Supply from excessive current & continuous shorted output
- CROWBAR OVER VOLTAGE PROTECTION on all Models **except RS-3A, RS-4A, RS-5A.**
- MAINTAIN REGULATION & LOW RIPPLE at low line input Voltage
- HEAVY DUTY HEAT SINK • CHASSIS MOUNT FUSE
- THREE CONDUCTOR POWER CORD
- ONE YEAR WARRANTY • MADE IN U.S.A.

PERFORMANCE SPECIFICATIONS

- INPUT VOLTAGE: 105-125 VAC
- OUTPUT VOLTAGE: 13.8 VDC ± 0.05 volts (Internally Adjustable: 11-15 VDC)
- RIPPLE Less than 5mv peak to peak (full load & low line)
- **Also available with 220 VAC input voltage**

MODEL RS-50A



MODEL RS-50M

MODEL VS-50M

RM SERIES

MODEL RM-35M

19" × 5¼ RACK MOUNT POWER SUPPLIES

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RM-12A	9	12	5¼ × 19 × 8¼	16
RM-35A	25	35	5¼ × 19 × 12½	38
RM-50A	37	50	5¼ × 19 × 12½	50
• Separate Volt and Amp Meters				
RM-12M	9	12	5¼ × 19 × 8¼	16
RM-35M	25	35	5¼ × 19 × 12½	38
RM-50M	37	50	5¼ × 19 × 12½	50

RS-A SERIES

MODEL RS-7A

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-3A	2.5	3	3 × 4¾ × 5¾	4
RS-4A	3	4	3¾ × 6½ × 9	5
RS-5A	4	5	3½ × 6⅛ × 7¼	7
RS-7A	5	7	3¾ × 6½ × 9	9
RS-7B	5	7	4 × 7½ × 10¾	10
RS-10A	7.5	10	4 × 7½ × 10¾	11
RS-12A	9	12	4½ × 8 × 9	13
RS-12B	9	12	4 × 7½ × 10¾	13
RS-20A	16	20	5 × 9 × 10½	18
RS-35A	25	35	5 × 11 × 11	27
RS-50A	37	50	6 × 13¾ × 11	46

RS-M SERIES

MODEL RS-35M

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
• Switchable volt and Amp meter				
RS-12M	9	12	4½ × 8 × 9	13
• Separate volt and Amp meters				
RS-20M	16	20	5 × 9 × 10½	18
RS-35M	25	35	5 × 11 × 11	27
RS-50M	37	50	6 × 13¾ × 11	46

VS-M AND VRM-M SERIES

MODEL VS-35M

- Separate Volt and Amp Meters • Output Voltage adjustable from 2-15 volts • Current limit adjustable from 1.5 amps to Full Load

MODEL	Continuous Duty (Amps) @13.8VDC	@10VDC	@5VDC	ICS* (Amps) @13.8V	Size (IN) H × W × D	Shipping Wt. (lbs.)
VS-12M	9	5	2	12	4½ × 8 × 9	13
VS-20M	16	9	4	20	5 × 9 × 10½	20
VS-35M	25	15	7	35	5 × 11 × 11	29
VS-50M	37	22	10	50	6 × 13¾ × 11	46
• Variable rack mount power supplies						
VRM-35M	25	15	7	35	5¼ × 19 × 12½	38
VRM-50M	37	22	10	50	5¼ × 19 × 12½	50

RS-S SERIES

MODEL RS-12S

- Built in speaker

MODEL	Continuous Duty (Amps)	ICS* Amps	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-7S	5	7	4 × 7½ × 10¾	10
RS-10S	7.5	10	4 × 7½ × 10¾	12
RS-12S	9	12	4½ × 8 × 9	13
RS-20S	16	20	5 × 9 × 10½	18

*ICS—Intermittent Communication Service (50% Duty Cycle 5min. on 5 min. off)

When you give the VOLTS command, the two values taken from RAM represent the most current data in both modes. This operation is necessary to observe RF power and power supply voltage drop during TX.

One interesting program feature is the channel statistics display. The SCN samples the TNC's DCD and PTT lines 30 times per second and computes their duty cycles. The ACTIVITY command shows this record, in 1-hour intervals, for the previous 12 hours. You can see when the BBS forwards late at night and the local activity picks up after 5 p.m.

You can set or clear individual port's bits one at a time with the S (C) command. The bit is used as a mask to modify the output port's image in RAM; then the data is copied to the port. If you change only one bit, the other functions on that port won't be affected by the new data. You don't have to know the previous settings for all other bits in a port. The SCN program reads the ports so you can see the new data and acknowledge it.

If a mailbox sends a script to the SCN at the beginning of a forward, the function will operate without knowledge of the other bits. When forwarding is completed, the mailbox can clear the desired bits.

A level of protection exists for Port 3 (output). You need a password to use this port and access the additional commands. Because of the protection feature built into Port 3, it would be inadvisable to describe the password implementation procedure here. I will, however, send information about adding this procedure to the system to anyone who orders the program object code.

Operation

To access the SCN from any packet station, simply establish a connection. This is exactly the same procedure you'd use to talk to another station, but the SCN will reply instead of another ham. The SCN recognizes the "*** Connected to xxx" message from the local TNC and responds with a sign-on message and menu. You can select an item from the menu:

- Examine the input ports.
- Command output ports.
- Review channel activity statistics.
- Monitor the analog inputs.

Refer to **tables 1** and **2** for more detail.

Several commands require only one letter: A, D, H, P, and V. You just send the letter (upper or lower case) followed by a carriage return. The SCN will respond with the information you requested.

You must enter the port and bit numbers to access commands that address a specific function. To enable an external device connected to the SCN you'd send S45 with no spaces. The first digit (in this case 4) indicates the port number and 5 indicates the bit of that port. Strings which are longer or shorter than three characters are invalid and don't affect the ports.

TABLE 1

Table 1. Menu

A	Activity: displays DCD and PTT statistics for the previous 12 hours.
Cpb	Clear bit port: clears (logic 0) the bit b of port p. Example: C10 clears bit 1 of port 0.
D	Disconnect.
H	Help: a short description of the commands.
P	Ports: returns hexadecimal equivalents of ports.
Spb	Set bit port: sets (logic 1) the bit b of port p.
T?s	TNC inquiry string: asks the TNC for the current value of parameter string s.
V	Volts displays all 4 analogs during both TX and RX.
X=n	Answer to problem, a 2-digit number, allows access to restricted commands.
X?	Requests a problem.

Port assignments: 0,1,2 & 3 are inputs; 4,5,6 & 7 are outputs. Bits are numbered 0 to 7; 0 is the least significant bit.

TABLE 2

Table 2. Restricted commands

T=s	TNC command, sends the string s to the TNC.
Z=n	Key number.
Z?	Displays the current key number during setup.

Static precautions

Both cards use delicate CMOS devices which require proper handling. Store loose devices in antistatic foam or bags. During assembly, lay a sheet of aluminum foil on the workbench. Use a wrist strap with a 10-meg resistor in series to connect yourself to the foil. Four items should be at the same electrical potential: the circuit boards, the components, the soldering iron, and you.

MCU card assembly

Use sockets for the MCU, EPROM, and the two Maxim parts. Solder in all other components on the MCU board, including the HC devices. Be sure to check for shorts between pins. Before installing the MCU and EPROM, apply +5 Vdc to the card and monitor the current. It shouldn't exceed 200 mA. For greater precision, you may want to install 1-percent resistors in all the analog signal processing circuits.

As a monitor, the 7-segment display shows a number indicating the task that is currently active. The display should count to 4 in about 4 seconds at power

TABLE 3

Table 3. Analog scaling matrix

Input Voltage	0.5	1.5	5	15
R1	short	short	2.43 k	12.4 k
R2	open	open	2.55 k	2.55 k
R3	10 k	10 k	249 k	249 k
R4	51.1 k	16.9 k	249 k	249 k
Divider	1	1	2	5.9
Gain	-5.1	-1.7	-1	-1

Note: All above values are standard 1-percent precision resistors.

up. If the display doesn't show the proper function, you'll need a scope or a logic probe suitable for CMOS.

To trouble shoot, check the applied voltages. See if reset has gone high and check the oscillator. The EPROM should be getting a series of chip enables. Determine if the MCU is running. Check for shorted or open address and data lines. Very little can go wrong with the circuitry and stop the processor.

Buffer card assembly

Build the power supply section first. Use a resistor to simulate the load of the MCU and buffer cards (200 mA). Apply power and check for proper supply regulation.

Determine the amount of I/O you want to build, multiply by 2, then put the components on the buffer card. You can test the discrete buffers before you install the 74HC373s by strapping the inputs high/low and observing their operation with a scope. You'll have to decide what signal levels you wish to monitor and scale the analog inputs using the values in **table 3**. Input signals greater than +5 volts require a divider stage. Scaling for 15 volts allows some headroom for battery chargers and power supplies running a little above normal. Adjust the reference voltage pot for 2.5 Vdc at the CPU.

Wiring

Maintain good static precautions and mount the boards in an environmentally tight enclosure. Construct four cable bundles from the cards to the chassis connectors — one for the power input, a second for the signals to the TNC, a third for the digital I/O, and a fourth for the analog inputs. Use shielded cables on the analog inputs and maintain good cable bundle separation. This will prevent coupling of the serial I/O noise to the outside and limit potential lightning problems.

Wire discrete lines and analog inputs with shielded cables. Be sure to terminate the shield at both ends. This level of protection is required because lightning strikes can induce destructive voltages.

Mate the two cards, but don't make any connections to the external devices. Turn on the SCN and watch the display for proper operation.

TNC hookup

For RS-232, connect only pins 2, 3, and 7 of the TNC. Set the TNC for 1200 baud, 7 data bits, even parity and 1 stop bit. Use a terminal to set the callsign and verify TNC operation. If you are using a TNC-1, be sure to perm the data and set the dip switch to use the stored values during initialization. Other TNC AX.25 parameters should conform to standards established in your area. Refer to **table 4** for some specific TNC settings and **table 5** for some specifics on the SCN.

TABLE 4

Table 4. TNC Settings

MON	OFF	XFLOW	ON
MCON	OFF	CONOK	ON
MALL	OFF	TRACE	OFF
FLOW	ON	BEACON	0
ECHO	OFF		

TABLE 5

Table 5. Specifications

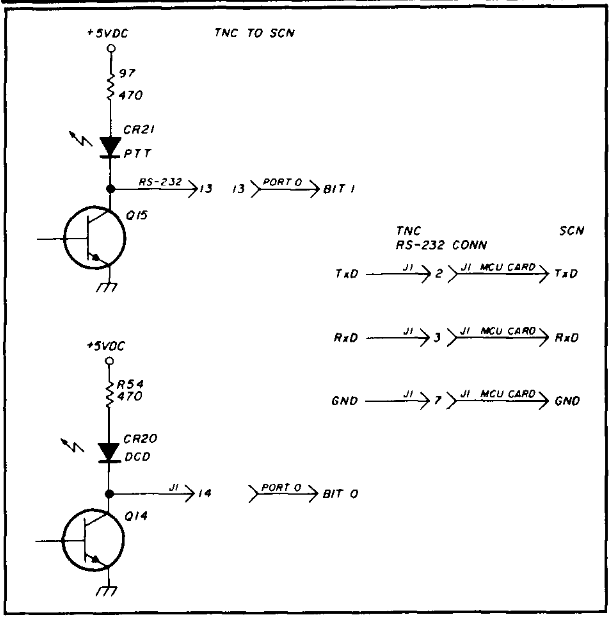
Serial Bus:	RS-232, 1200 baud, 7 data bits, even parity, 1 stop bit, on board ± 10 volt generator, recognizes TAPR TNC commands.
Inputs:	Discrete inputs: 2 ports, (16 bits). Analog inputs: 4. User determines scaling, 8-bit resolution.
Outputs:	Discrete: 2 ports (14 bits) with high level driver (200 mA/bit).
Additional ports:	2 uncommitted ports (16 bits). User selects type of buffering or drivers.
Power input:	8 to 15 volts, AC or DC @ 200 mA.
Size:	2 boards, each approximately 6.5 × 4.75 inches.

There are enough unused RS-232 connector pins on both the TNC-1 and TNC-2 so that two can be freed and used for DCD and PTT. This allows a single connector to make all TNC to SCN circuits. Break the connector pin to ground lines in the TNC. Now wire from the connector pins to a point which goes to ground to light the appropriate LED. If you get the wrong side of the LED or current-limiting resistor, the signal won't go low enough. Use a meter to determine the proper point in your TNC. See **fig. 4** for more details.

Setup

You'll need a null modem adapter to connect a terminal to the SCN. This swaps the functions of pins

FIGURE 4



TNC to SCN interconnection

2 and 3. The SCN configuration is Data Terminal Equipment (DTE) and the terminal is Data Communications Equipment (DCE) during setup. With the SCN turned off, set dip switch number 4 (bit 3) to on and apply power. The SCN will come up in setup mode so you can enter the key number using the Z= and Z? commands. When you've completed this step, remove power and set switch number 4 to OFF for normal operation. The null modem adapter isn't required for normal operation with the TNC.

If everything looks good, connect the TNC to the radio and the SCN to the various equipment. Apply power to the TNC and then to the SCN. To test the system, use another packet station and perform a connect request and select from the menu items.

Conclusion

This system is simple to operate and has a great deal of utility. Its variety of inputs and outputs should meet most of your needs. The system's real flexibility is demonstrated with each unique implementation that adds a little different flavor to packet radio.

Software and pc boards

If you'd like the program object code, it's available in two forms — a programmed 27C64 which works directly in the circuit ($12) or an IBM compatible PC disk with the files in both Motorola S record and raw hex format ($5). You may copy and distribute the object code in either form. A set of double-sided pc boards is also available for $50. I can also send you the CPU and Maxim parts. For more information, write me at the address listed at the beginning of this article.

Article D · **HAM RADIO**

THE HAM NOTEBOOK

The 12-meter "garage plane" antenna

Are you weary of trying to explain your compromise antenna for the new 12-meter band? If you yearn for an antenna dedicated to this band you might want to try my idea. Some of the attractive assets of the "garage plane" are:

- Low cost (ridiculously low)
- Simple construction
- Easily tuned
- Respectable SWR
- Unobtrusive

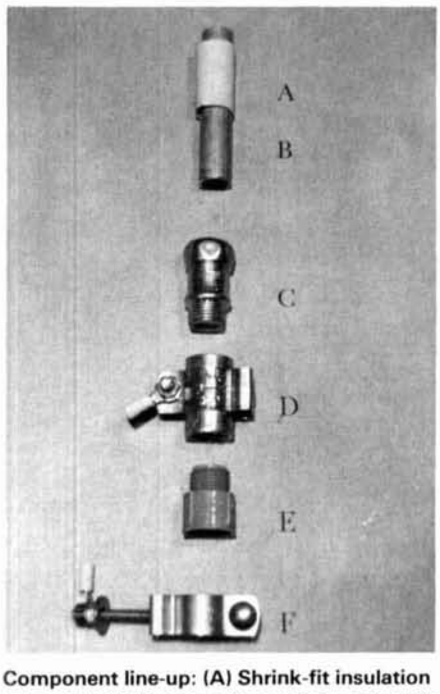
I got the idea of using my garage as an antenna base when I ran out of room to mount antennas on my modest suburban lot. My garage was the only unadorned area left. It also has a hip roof design allowing installation of a drooping ground radial configuration.

The major cash outlay for this project was the purchase of a 10-foot length of 1/2″ thin-wall conduit. You can buy it at most hardware and building supply stores for less than $3. The other parts will probably cost you about another $3.

The first construction step is probably the most difficult; it's making the decision to drill a 3/4″ hole through the garage roof. After you've done this, the rest is relatively easy. (See **photos A** through **C** for construction details.)

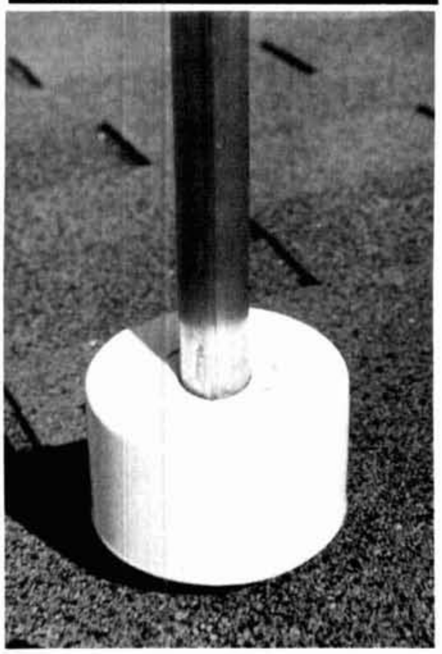
The antenna is a basic ground plane, nothing new. The 8 radials are cut to 9′ 2-1/2″. Four are stapled to the underside of the hip ridge rafters. The others are spaced equally between the ridges and stapled to the underside of the midpoint rafters. I made the radials out of scrap 12-gauge stranded wire. Cut the radiator to about 9′ 6″ initially; then follow standard antenna pruning procedure to obtain minimum SWR. (I used a copper-tubing cutter.) I got optimum resonance at a combined

PHOTO A



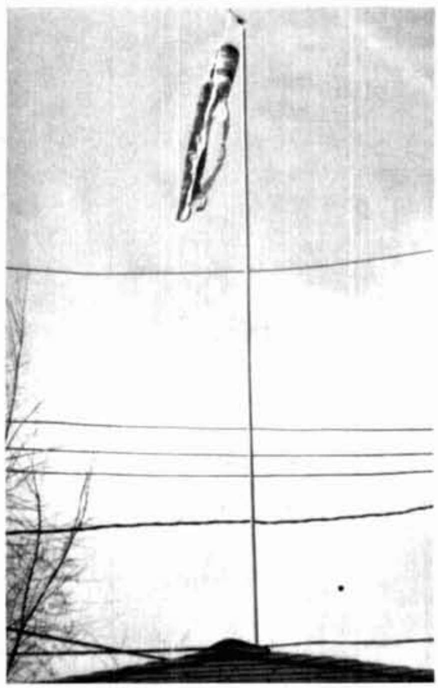
Component line-up: (A) Shrink-fit insulation tube, (B) 1/2″ thin-wall conduit, (C) 1/2″ conduit compression fitting, (D) 1/2″ coupling with 3/4″ conduit hanger and 1/4-20 bolt and nut, (E) 1/2″ PVC to pipe fitting, (F) 3/4″ conduit hanger with 1/4-20 bolt and nut. Note: The bolt in item D is used for connecting the center conductor of the coax. The bolt in item F is used for connecting the assembly to a board under the roof, as well as for the shield of the coax and the 8 radials.

PHOTO B



Rainproofing. A cap from a can of spray paint serves as a water shield.

PHOTO C



The radiator. Note the wind sock. Powerlines in the background are 35 feet behind the antenna.

(conduit plus fittings and unshielded coax) radiator length of 9′ 2-1/2″. This meant a conduit length of about 8′ 10-1/2″. The SWR at this length was 1.2:1 across the entire band.

Now before closing the garage door and returning to the shack to verify your antenna's on-the-air performance, seal the hole in the roof with roof patch cement or silicone rubber. As an added weatherproofing measure, you can use the plastic cap from a spray paint can. Punch a hole in the center of it with a scrap of the conduit. Slide the cap over the conduit (right side up) until it's just above the roof shingle and then seal it in place.

Performance tests indicated the following:

Item Tested	Garage Plane*	Inverted V dipole**
Noise level	Slightly above	Reference
Directionality	Omni	Almost Omni
TVI***	None	None
Signal Received (Average)	+1 1/2 S-units	Reference
Signal Transmitted (Average)	+1 1/2 S-units	Reference

While these statistics show that perhaps the antenna excels more in uniqueness of construction than it does in performance, the +1 1/2 S-units consistently reported can't be ignored. Keep in mind that this antenna was erected primarily as a general purpose device to enable 12-meter operation without resorting to antenna tuners and makeshift antennas.

I hope you enjoy building and using your 12-meter antenna as much as I've enjoyed mine. The antenna is so good that it even defied the unwritten law, "An antenna's performance rating is directly proportional to the adverse weather conditions encountered during installation." The antenna was erected on a clear, warm, and sunny day and it works great!

Richard St. Amant, W8PDV

*Stations worked during the test ranged from South Africa, Greece, the Caribbean, and California.

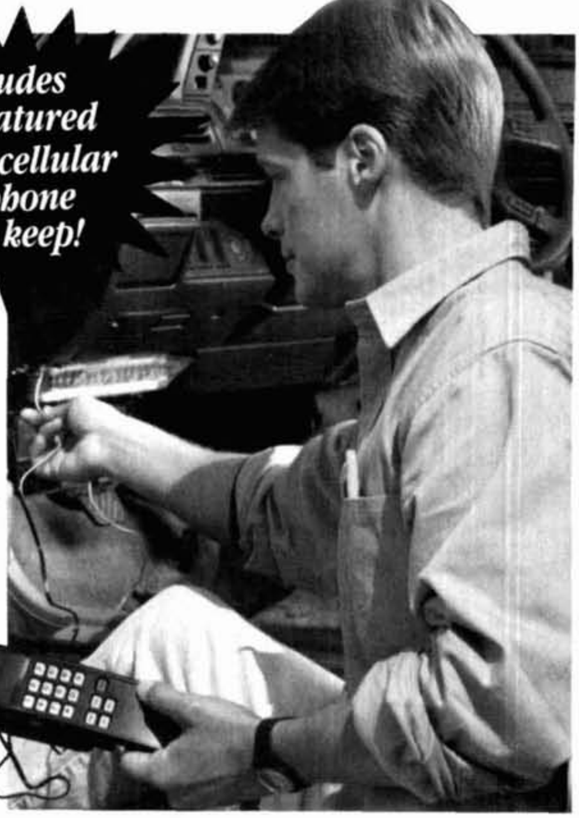
**The feedpoint of the inverted V antenna was at an elevation level with the center of the garage plane radiator, about 16 feet above ground.

***The TV antenna on the set used for TVI verification is located 35′ from the center of the garage plane. TV antenna height is 16 feet above ground. The TV set was located next to the transceiver. TV transmitters averaged 20 air miles away.

Article E

New! NRI course in Cellular Telephone Installation and Servicing prepares you to succeed in today's fastest-growing communications field

Includes full-featured mobile cellular telephone you keep!



Now you can get the skills you need to cash in on today's booming cellular industry as you install and test your own state-of-the-art cellular telephone.

Cellular business is big business!

In the few short years since the first commercial cellular telephone system went on-line, over 1,000,000 people have signed up for service in more than 120 cities nationwide. Today, the industry is growing at an incredibly fast 4% a month, and experts predict that by 1991, at least 85% of the United States will be covered for cellular service. Better yet, by 1993 total industry revenues will exceed $10,000,000,000—making cellular the fastest growing electronics communications field today.

For you, that means extraordinary career and money-making opportunities. Get a fast start today with NRI's hot new course in Cellular Telephone Installation and Servicing. See how far you can go!

Help wanted! Urgent demand for field technicians who can install and test new cellular telephone equipment!

Get the skills, knowledge, and confidence to install and test cellular telephone equipment, and you can name your price in this exploding new job market. Cellular system developers, retailers, and service providers—all on the ground floor of an industry that's still so young and growing so fast—are all willing to pay a premium for anyone trained to service this brand-new equipment.

Now, with NRI, you can take full advantage of every exciting opportunity in today's—and tomorrow's—booming field of cellular communications.

Exclusive hands-on training includes high-performance mobile cellular telephone you keep

Your NRI course starts with the electronics fundamentals you need to understand and service all telephone systems, then walks you step by step through the installation, troubleshooting, and repair of popular telephone systems in use today.

But that's just the beginning. With a solid conventional phone servicing foundation behind you, you're ready to build your expert understanding of the cellular telephone systems moving fast into communities all over the U.S.

Following complete, easy-to-read guidelines, you install a full-featured mobile cellular telephone in your own car, then take it through a series of diagnostic tests to become fully acquainted with its operating functions. Best of all, if you live in an area already offering cellular coverage, NRI will help you actually go on-line with up-to-date, expert advice on choosing the best and most affordable cellular service available.

10-digit luminescent display with 24-digit number entry/review

Ignition sense automatically turns your phone on and off with car's ignition

Electronic lock prevents unauthorized use of your phone

22 memories including last number called

Super speed dialing and 1 digit recall

Send for your FREE catalog today

For all the details about NRI's exclusive new training, send the coupon today. You'll receive a complete catalog describing NRI's Cellular Telephone Installation and Servicing course plus NRI courses in other high-tech, in-demand fields.

If the coupon is missing, write to NRI School of Electronics, McGraw-Hill Continuing Education Center, 4401 Connecticut Avenue, Washington, DC 20008.

Send Coupon Today For Free Catalog!

NRI School of Electronics
McGraw-Hill Continuing Education Center
4401 Connecticut Ave, Washington, DC 20008

For career courses approved under GI Bill ☐ check for details.

☑ **CHECK ONE CATALOG ONLY**

☐ **Cellular Telephone**
☐ Computer Electronics
☐ TV/Video/Audio Servicing
☐ Electronic Music Technology
☐ Data Communications
☐ Security Electronics
☐ Robotics
☐ Basic Electronics

Name ______________________ Age ______

Street ______________________

City/State/Zip ______________________

Accredited by the National Home Study Council 20-039

QSK MODIFICATION FOR THE TRIO-KENWOOD TL-922 AMPLIFIER

By **Richard L. Measures, AG6K,** 6455 La Cumbre Road, Somis, California 93066

The TL-922, while a beautifully constructed amplifier, is not suited for full break-in operation like AMTOR or QSK-CW. For those who enjoy working SSB/VOX, a QSK modification is worthwhile because it reduces relay noise.

In this article I'll describe one method of converting the TL-922 to QSK. I also have available a companion article on circuit improvements other than QSK for the TL-922. A list of parts suppliers is included.*

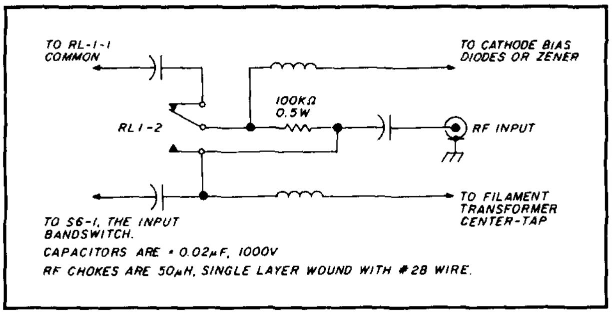
QSK

There are two popular methods of RF switching for QSK: PIN switching diodes and high-speed relays. The PIN diodes are quieter and faster, but they're also subject to damage from electrostatic discharges like lightning in the near field of the antenna, and their related circuitry is complex to construct. High-speed relays aren't as fast as PIN diodes, but they can do the job of switching the amplifier from receive (RX) to transmit (TX), or TX to RX, in about 3 mS. This is fast enough for Amateur Radio applications. The high-speed relay's acoustic noise problem can be minimized with an appropriate relay mounting technique.

You can perform TX/RX cathode-bias switching in the TL-922 with an optoisolator driving an NPN power transistor. An alternative method is to use two 50-μH RF-isolating chokes and three 20-nF (0.02 μF), 1-kV, DC-isolating capacitors on the input relay contacts (see **fig. 1**). These components allow the input relay contacts to simultaneously switch the RF input and the DC cathode-bias currents. I'll show both methods.

There are two manufacturers of suitable (vacuum) high-speed relays that will handle 2450 watts (7 A in a 50-ohm circuit) up to 32 MHz. They are Kilovac, Inc., Santa Barbara, California and Jennings Radio, Inc., San Jose, California. These relays are the Kilovac HC-1 ($93) and the Jennings RJ-1A ($95); the two relays are virtually interchangeable. When driven by a 26-volt source, they are rated at ≤6 mS and ≤8 mS switching speeds, respectively. The rated speeds tend to be on the conservative side of each relay's measured capability.

FIGURE 1



Circuit showing one method of providing QSK operation. This method uses two 50-μH isolating chokes and three 0.02-μF isolating caps on the input relay.

Before any relay can actuate, current must flow in the relay's coil. In order for this current to flow, the inevitable inductance in the coil must be overcome. Theoretically, this process can take place in no time *at all* if a perfect constant current source is used to drive the coil. Unfortunately, this requires a current source that's capable of infinite voltage at T = 0. Infinite voltage, besides being a large order, is going to cause a big problem for the insulation in the relay's coil and anything else in the same room! It just isn't practical.

When driven by a voltage-limited current source, a relay can be made to switch faster without the risk of coil insulation damage. You can construct a voltage-limited current source by placing 600 ohms in series with the TL-922's internal +110 volt power supply. The 600-ohm (two 300 ohm in series) resistor limits the relay coil cur-

*The price of the companion article is $2 delivered to any North American mailing address. For overseas delivery add $2. A supply of ≈ .1mm oxygen-free copper-foil, for making the RF connections to the vacuum-relays, and the #8-32 self-clinching nut, for the QSK-relay subassembly, is furnished with each article. For a retrofit-kit, to incorporate one of these circuit-improvements see page 124 of the December 1988 issue of *Ham Radio Magazine*.

rent to the correct ≈ 80 mA at 26 volts for each of the two 335-ohm relay coils in series and allows ≈ 55 volts to appear briefly across each relay coil at T = 0. This speeds up the make time of the relay. Both brands of relays had a measured make time of less than 2 mS with this circuit.

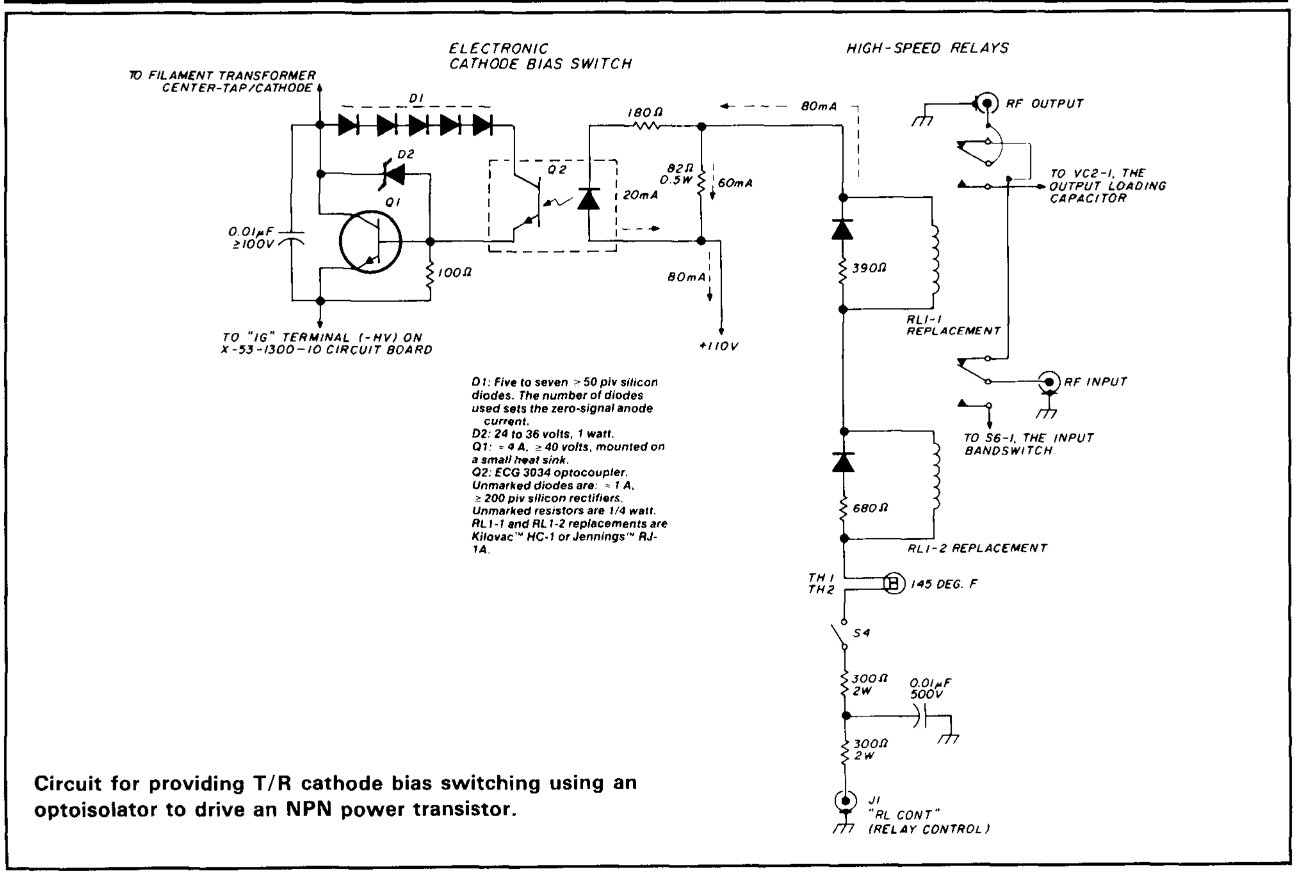
It's possible to control the break (release) time of a DC relay by the amount of external resistance placed in parallel with the relay coil. The external resistor is usually connected in series with a reverse diode so that the resistor doesn't act as a current burden during the on cycle. If the resistor is omitted (R ≈ inf), the coil voltage spike may rise to several hundred volts (reverse polarity) on break and the relay's break time will be very fast. The voltage spike is caused by the too-rapid collapse of the magnetic field in the relay coil (like the spark coil in a gasoline engine). The voltage spike isn't good for the insulation in the relay's coil or anything else in the circuit. This is why a reverse-connected diode is often placed in parallel with a DC relay's coil. The diode will also stretch the relay's break time considerably. In a full break-in application, a diode alone would provide too much break time, so a resistor is placed in series with each reverse diode to speed it up. When appropriate resistances are chosen, break times can be controlled accurately for correct break-time sequencing of two or more relays.

In **fig. 2**, the circuit diagram for this QSK circuit, the resistor on the output relay's coil has less resistance than the resistor on the input relay's coil. This keeps the output relay connected to the antenna slightly longer than the input relay can apply drive to the amplifier tubes, and assures that the output relay won't be opening (and arcing its contacts) before all of the drive power is removed.

An electronic cathode-bias switch replaces RL2-1 (the cathode-bias relay), D2 (the cathode-bias zener), R7, and C25. The new cathode-bias switch is an NPN power transistor, shown in **fig. 2**. The new circuit lets you adjust the zero-signal anode (plate) current in steps. The transmit bias voltage is adjustable in ≈ 0.8 volt steps. Normal transmit cathode bias is approximately + 5 volts. During receive, + 24 to + 36 volts cuts off the 3-500Z's anode current.

An optocoupler drives the transistor switch. The optocoupler's resistor shunted input is connected in series with the relay control line. When current (80 mA) flows in the relay control line, 20 mA flows through the optocoupler's LED input and the optocoupler turns on.

FIGURE 2



Circuit for providing T/R cathode bias switching using an optoisolator to drive an NPN power transistor.

This activates the switch transistor, which turns on the 3-500Zs.

You can adjust the quiescent, or zero-signal, anode current of the 3-500Zs by shorting or unshorting the series diodes in the collector lead of the optocoupler. The correct SSB quiescent anode current is 160 to 200 mA. Lowering this current makes the tubes harder to drive and increases the IMD products. Too much current makes excessive heat and reduces efficiency.

Relay mounting and wiring

Mount the vacuum relays side by side on a rectangle of ≈ 14 gauge aluminum. Bolt a length of 12 mm × 12 mm aluminum right-angle stock to the bottom of the rectangle to form a mounting bracket. Press a self-clinching nut into a hole in the angle stock. Fasten the bracket to the top of the chassis with a screw passed through one of the mounting holes for the original relay.

To reduce acoustic noise, mount the relays without using the furnished hardware. To provide side clearance, make the relay mounting holes 2-3 mm larger than the threaded mounting shafts on the relays. Shock mount each relay with three "pillows" of silicone rubber. I prefer the red high-temperature General Electric Company silicone-rubber adhesive sealant.

It's important to have the relays positioned so that no metal-to-metal contact occurs between the relay and the aluminum mounting plate. If contact is made, there will be an acoustic path between the relay and the chassis of the amplifier — very much like the (sound) bridge on a violin — and the chassis will act as a sounding board. To keep the relays in the correct position while the silicone-rubber pillows are curing, cement* three cardboard rectangular spacers temporarily around each of the mounting holes for the relays.

Silcone rubber adheres well to most materials *if* the surface is prepared properly. I've found that the best surface-conditioning material is the silicone rubber itself. If the surface is greasy, clean it with a no-residue degreaser like TCE or Freon™ TF. Next, apply a dab of silicone rubber to a small, clean cloth and forcefully rub a thin film of silicone rubber onto all of the surfaces you want to bond together. (This information is not in the directions.) Apply the bonding silicone rubber immediately, before the conditioned surfaces start to cure. Add three dabs of silicone rubber before inserting each relay into a mounting hole. A small amount of silicone rubber will do the job; an excess will enhance the sound conduction to the mounting place. No silicone rubber should touch the cardboard strips because they'll be removed after curing. Now set the assembly aside for 48 to 72 hours of undisturbed curing. After curing, remove the cardboard strips.

* Stationery-store type rubber cement is suitable for this purpose.

Ground the metal bases of the relays electrically to the aluminum mounting plate. Do this by removing some of the paint from the relay bases and soldering a ≈ 14 mm long, 3 mm wide, flexible S-shaped strip of ≈0.1 mm copper foil to each relay and a ground lug to the mounting plate. The relay assembly must permit the relays to move in their holes slightly without touching the metal mounting plate.

Wiring the relays

The relay's coil terminals can break off easily with a sudden impact or too much stress. The wires that connect to these terminals should be flexible (no. 24 gauge stranded wire is satisfactory). Wire the RF terminals with 0.1-0.2 mm thick copper foil strips, 3 mm in width.

Don't use stiff wires to make a direct connection to the relay's RF terminals as this would provide a sound conduction path away from the relay. If you need to make a connection between an RF terminal and a stiff wire, solder a 3 mm × 20 mm flexible bridge of copper foil between the wire and the relay terminal. This will reduce sound conduction and stress on the relay.

All of this may sound like a lot of trouble, but the quiet that results is worth the effort.

Optimizing 10-meter bypass SWR

One frequently overlooked refinement in commercial amplifiers is apparent when the amplifier is switched off (bypassed), connected to a 50-ohm nonreactive load whose SWR = 1:1, and you find that the 10-meter input SWR to the amplifier is much worse than expected. This problem is caused by the inductive reactances in the T/R relays and their associated wiring. These inductive reactances can be canceled by connecting a capacitor (1-kV rating) of the proper value from the common terminal of the output relay to ground. Find the value of this capacitor experimentally by installing a 50-pF variable capacitor temporarily at the point in question. Adjust the capacitor until the 10-meter SWR is at a minimum when the amplifier is off. Do this with an accurate 50-ohm termination connected to the amplifier's output connector. Remove the capacitor and measure its capacitance on a capacity meter. Then permanently install a fixed capacitor of the closest standard value. In my amplifier it turned out to be 36 pF, 1 kV.

Odds and ends

- After you remove RL2, cover the hole in the chassis to maintain correct cooling air flow. With RL2 removed, the "ON THE AIR" lamp doesn't light on transmit. If this is important to you, it's possible to wire the lamp in series with the relay control line — provided that the value of one of the 300-ohm resistors is lowered to 240 ohms to offset the extra 6-volt drop in the lamp. You can control the lamp current by placing a resistor in parallel with the lamp.

• Prolong the life of the meter lamps either by increasing the resistance of the 10-ohm resistors that are in series with each lamp to 20-24 ohms, or by rewiring the circuits so that one 10-ohm resistor carries the current for each pair of meter lamps.

• If you own a TS-440 or TS-940 you may wish to eliminate the less-than-silent mechanical relay that operates the remote jack's (amplifier) relay control circuit. This relay can be replaced, *for positive voltage relay control switching only*, by an NPN switching transistor and two resistors. A schematic of this circuit is included (see **fig. 3**). The circuit will work on other makes of transceivers that use a mechanical relay for this job.*

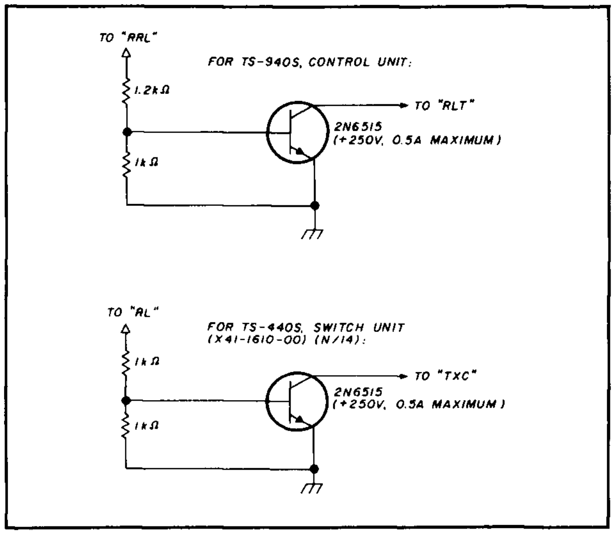
• You may have noticed that the full break-in circuit doesn't use a bypass capacitor directly across the TL-922's "RL CONT" (relay control) jack. There is a 300-ohm resistor between the bypass capacitor and the jack so that the switching relay or transistor in the transceiver isn't required to directly short out the bypass capacitor (which is charged to + 115 volts during receive). A direct short on a charged capacitor can easily create a nanosecond discharge current pulse of more than 100 A. In time, the pulse of current will erode the contacts of the transceiver relay that keys the "RL CONT" circuit. The current pulse can damage a 0.5-A switching transistor in short order. The 300-ohm resistor limits the peak switching current to less than 0.4 A.

• To tune up the TL-922 (or any grounded-grid amplifier) correctly, without using a two-tone generator and oscilloscope or a tuning pulser[1], follow these steps: Set the amplifier to the CW position, apply full CW drive power, and adjust the amplifier's tune and load controls alternately for maximum relative power output. The complete tune-up should take less than 10 seconds. The amplifier is now tuned up for CW or SSB operaion. The mode switch should be set to SSB for voice use.

Cost reduction

You can reduce the cost of the QSK conversion by about $80 if you use a less expensive high-speed relay to switch the 100-watt input circuit of the amplifier. The Trio-Kenwood TS-440S uses a Matsushita Electric Company high-speed, SPDT reed relay (Trio P/N: S51 1429 00) to switch the antenna circuit of the transceiver. This reed relay can handle 100 watts with ease, and the switching speed is probably under 1 mS — about twice

FIGURE 3



Solid-state relay switching circuits for use with the Kenwood TS940 and TS440.

as fast as the vacuum output relay. Take one important precaution: be sure that the reed relay doesn't apply drive power to the TL-922 before the output relay can connect the load to the amplifier. It may be necessary to add a make-delay circuit to the faster relay. *This relay is not suitable for switching the cathode bias.* Use it only with the electronic cathode-bias switch circuit. It's important to make sure that the reed relay has the correct 12 volts to operate the coil. The relay control current of 80 mA is far too much current for the reed relay's coil, so you must dump the extra current into a coil shunt resistor of the appropriate calculated value. The 600-ohm resistor in series with the relay contol line must be increased by 175 ohms to drop the added 14 volts (as the result of using a 12-volt coil in place of a 26-volt coil).

Use in other amplifiers

This QSK modification circuit will work in other amplifiers that use a + 110 Vdc relay power supply. I added QSK to a Heathkit SB-220 with this circuit. It works as well as the modified TL-922.

Parts suppliers

Vacuum-Relays: Surcom (Jennings), 619-438-4420. Ask for Lenk.
Kilovac, 805-684-4560. Ask for Gail. Either supplier will ship UPS/COD.

If you have any questions please write, or phone 805-482-3034. Most questions can be answered more accurately and promptly on the telephone than by letter.

References

1. R.L. Measures, AG6K, "Adjusting SSB Amplifiers," *Ham Radio*, September 1985, page 33.

Article F **HAM RADIO**

* Many QSK-transceivers use a slow-acting, conventional relay to key the relay-control circuit from an external amplifier. The conventional relay in the transceiver causes a needless and often excessive time delay in the operation of the QSK relays in the amplifier. In some cases this delay may cause RF drive to be applied to the amplifier ***before*** the relays in the amplifier have had a chance to close. *The conventional, amplifier-keying relay in the transceiver should be replaced with a switching transistor circuit like the one shown in* **fig. 3**. This circuit requires a + 9 to + 12 volt, ≈ 10-mA signal on TX and ≈ 0 volts on RX. This voltage can be obtained from the point where the original ≈ 12 volt relay coil was connected in the transceiver circuit.

NEW BOOKS

ARRL ANTENNA BOOK

by Jerry Hall, K1TD, NEW 15th Edition

The all new 15th edition of this antenna classic represents over two years of hard work by editor K1TD. It's doubled in size too --from over 300 to over 700 pages big! 950 figures and charts cover just about every subject imaginable. Some of the highlights are: Chapters on Loop antennas, multi-band antennas, low frequency antennas, portable antennas, VHF and UHF systems, coupling the antenna to the transmitter and the antenna, plus p-l-e-n-t-y more. Like the 1988 HANDBOOK and new OPERATING MANUAL, the new ANTENNA BOOK is going to be a smash hit. Order yours today. 15th edition 900 + pages ©1988

AR-AM **Softbound $17.95**

NOVICE ANTENNA NOTEBOOK

by Doug DeMaw W1FB

Novices have long wondered what is the best all around antenna for them to install. Up until now, this was a difficult question to answer. Aimed at the newly licensed Ham, DeMaw writes for the non-engineer in clear concise language with emphasis on easy-to-build antennas. Readers will learn how antennas operate and what governs performance. Also great reading for all levels of Amateur interest. 1st Edition ©1988.

AR-NAN **Softbound $7.95**

THE 1989 ARRL HANDBOOK

FOR THE RADIO AMATEUR (Avail. late Oct. 1988)

Revised and updated with the latest in Amateur technology, now is the time to order your very own copy of the world famous ARRL HANDBOOK. In addition to being the definitive reference volume for your Ham shack, there are plenty of projects for every interest in Amateur Radio — from antennas for every application to the latest state-of-the-art projects — you'll find it all in the 1989 HANDBOOK. Order now and we will ship as soon as the books arrive from the printer. They make perfect gifts for the holiday season for your hard-to-buy for Ham friends or for yourself. Over 1100 pages ©1988.

☐ **AR-HB89** **Hardbound $20.95**

N6RJ's ELECTRONIC SECOND OP for MS-DOS computers

by Jim Rafferty N6RJ

The world famous SECOND OP is now available in a state-of-the-art computerized data base. This program, written for MS-DOS computers, is a must for DX'ers, contesters and all Amateurs interested in reliable DX communication. Data can be displayed either in columnar format or in full screen displays. Unknown callsigns can be entered and compared to the ITU callsign allocation for easy identification. There's plenty more too such as: postal rates, beam headings and QSL bureaus to name just a few. Great program to have in your shack. Order your's today. ©1988 MS-DOS computers. 5¼ and 3½ versions available. Please specify on your order.

☐ **CB-RJ** **(MS-DOS Computers)** **$59.95**

1989 AMATEUR CALLBOOKS

(Available late November 1988)

NORTH AMERICAN EDITION

Fully updated and edited to include all the latest FCC and foreign government callsigns and addresses for Hams in North America. Includes plenty of handy operating aids such as time charts, QSL bureau addresses, census information and much more. Calls from Northern Canada to tropical Panama. Now is the time to buy a new Callbook when you'll get the most use out of your investment. ©1988

☐ **CB-US89** **Softbound $25.95**

INTERNATIONAL EDITION

QSL's are a very important part of our hobby. All sorts of awards, including the coveted DXCC, require confirmation of contact before the award can be issued. Of special interest, addresses are being added daily for Hams in the USSR and other countries. While in no means complete, it's a start and will be of tremendous help in getting QSLs. Handy operating aids round out this super book value. ©1988

☐ **CB-F89** **Softbound $28.95**

BUY 'EM BOTH SPECIAL
Reg. $54.90 Only $49.95
SAVE $4.95

Please enclose $3.50 shipping & handling.

(800) 341-1522

(ORDERS ONLY)

"You're miles ahead with Larsen."

Rick Woodsome, Communications Consultant
Woodsome and Associates, Boulder, Colorado

When the directors of the Coors International Bicycle Classic needed a sophisticated mobile communications system, they turned to communications consultant Rick Woodsome. As a communications specialist, Woodsome knows what it takes to make a communication system work.

That's why he turned to Larsen Antennas.

"You don't pull off the largest sports event in the Western Hemisphere without good communication. And you don't have good communication without the right equipment.

"Larsen antennas were instrumental in making last summer's Coors Classic an overwhelming success. They were key to our entire communication network.

"Without Larsen, it would have been uphill all the way."

Rick Woodsome

THE AMATEUR'S PROFESSIONAL.

Larsen Külrod® and Külduckie® antennas provide amateurs the same advantages enjoyed by commercial two way radio users. Both combine top performance with the long range dependability you want.

See your dealer for the complete line of Larsen antennas and permanent and temporary mounts. You can buy with confidence, because they're all backed by Larsen's No Nonsense Warranty for a full six months.

For a professional approach to amateur radio, tune in to Larsen.

Larsen Antennas
The Amateur's Professional™

See your favorite amateur dealer or write for a free amateur catalog.

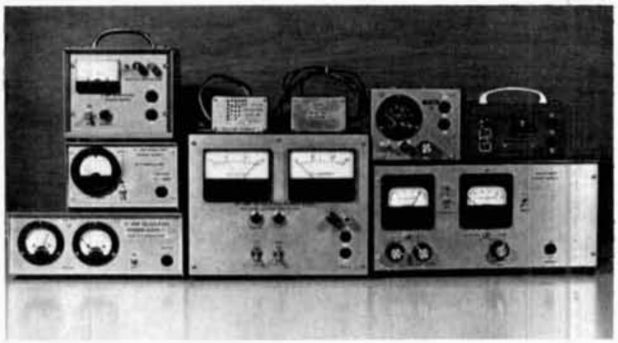
✓ 178

IN USA: Larsen Electronics, Inc., 11611 N.E. 50th Avenue, P.O. Box 1799, Vancouver, Washington 98668 (206) 573-2722.
IN CANADA: Canadian Larsen Electronics, Ltd., 149 West 6th Avenue, Vancouver, B.C. V5Y 1K3 (604) 872-8517.

UNDERSTANDING AND USING 723 VOLTAGE REGULATORS

Simple circuits for chargers through test bench use

PHOTO A



All units use the 723 voltage regulator. Left—13.8 volt power supplies. Center—On top of the 28 A 13.8 volt power supply are two quick/trickle chargers. Right—On the bottom is a bench power supply. Above, battery charger (black meter) and to its right a 1.6 A 13.8 volt power supply.

I have read many articles on voltage regulation and power supplies and always learn something new from each one. I built my first-regulated, current limited power supply over 10 years ago. Since that time I have built quite an assortment of low-voltage dc power supplies. **Photo A** shows a few of them. In fact, not everything in the photo is a "power supply" — I'll explain that later.

Everything in **photo A** has one thing in common, the "723" voltage regulator (LM723CN, μa723CN, or equivalent number). It's adjustable from 2 to 37 volts, and has foldback current limiting. These features make it extremely versatile. This is basically an article on applications, but you'll still need an understanding of the circuit used with the 723 regulator (**fig. 1**).

basic components

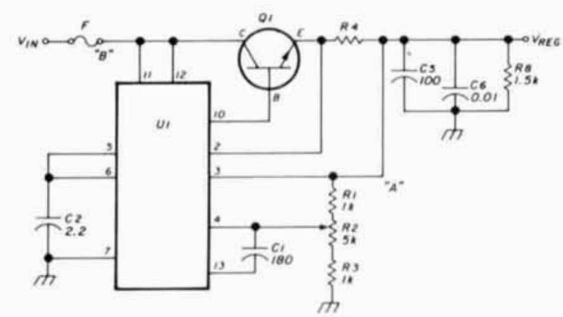
The projects focus on three items: R2, the voltage adjustment; R4, the current limit resistor; and Q1, the pass transistor. By varying these three things you can construct some interesting and useful equipment.

R2 is used to vary the voltage (**fig. 1**) from about 7 to 37 volts, less if V_{in} is less than 40 volts. (A different circuit for the 723 is required for voltages from 2 to 7 volts and will not be discussed here.)

R4 is a current limit resistor. The 723 regulator limits the flow of current through Q1 when it senses a voltage drop (on pins 2 and 3 of U1) of approximately 0.65 volts across R4. If R4 is 1 ohm, the current limit is 650 mA; 10 ohms for R4 gives a 65-mA current limit and 0.1 ohm gives a 6.5-A current limit.

Pass transistor, Q1 in **fig. 1**, handles the desired current load. Most sources rate the 723 regulator at 150 mA but I've seen it rated at 50 mA. Although the 723 regulator is protected by thermal shutdown, I've found that it can only stand a couple of shutdowns before failure. Because most of the uses for the 723 regulator require more than 150 mA, the pass transistor or multiple-pass transistors are used to handle the desired maximum current. My experience shows that the 723 regulator likes loads well under 50 mA.

FIGURE 1

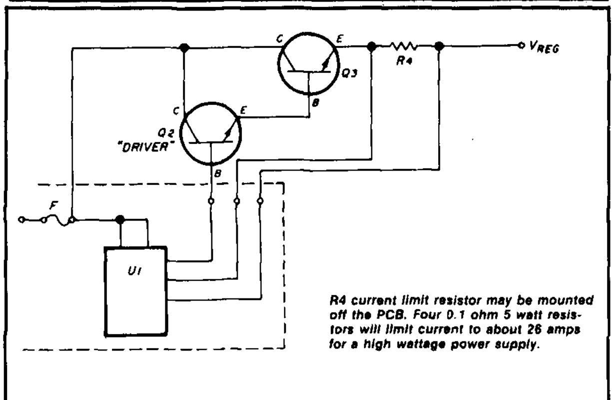


Basic 723 regulator circuit with pass transistor is adjustable from about 8 volts to 30 volts with appropriate V_{in}.

The 2N3055 in a TO-3 case is a good choice for the pass transistor. It is an inexpensive power transistor rated at 15-A and 115-watts dissipation. I never push the 15-A rating but would rather use several pass tran-

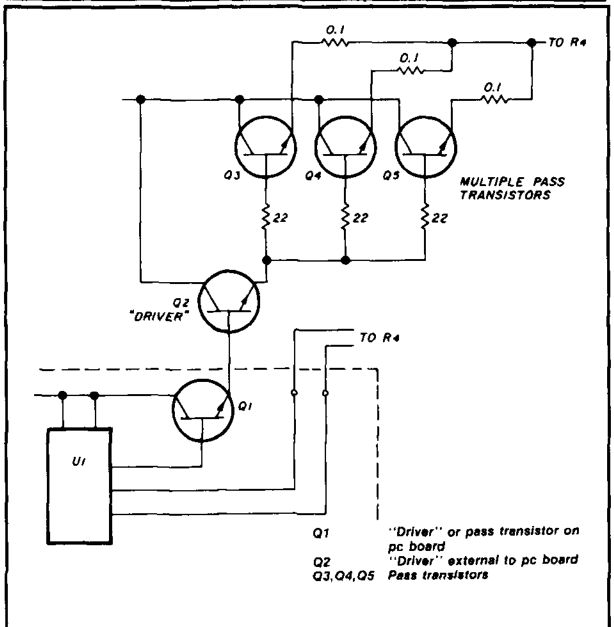
By W.C. Cloninger, Jr., K3OF, 4409 Buckthorn Court, Rockville, Maryland 20853

FIGURE 2



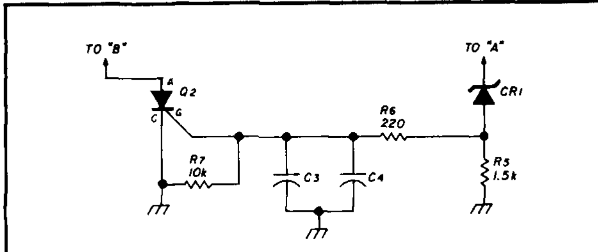
Use of "Darlington pair" (Q2, and Q3) for pass transistor reduces load on the 723 regulator.

FIGURE 3



Multiple pass transistors (Q3, Q4, and Q5) with load balancing emitter resistors for high amp applications.

FIGURE 4



Typical "crowbar" overvoltage protection circuit using a zener diode for voltage reference.

parts list

C1	100 to 500 pF
C2	2.2 μF tantalum
C3,C4	0.05 to 10 μF
C5	100 μF
C6	0.01 μF
CR1	15 v 1 watt zener diode
Q1	2N3055
Q2	SCR to suit current wax
R1,R3,R5	1k ohms
R2	5k potentionmeter
R6	220 ohms
R7	10k ohms
R8	1.5k ohms 1 watt
U1	LM723CN regulator
R4	Current limit resistor 0.1 ohm 5 watt wire wound for 6.5 A limit; 10 ohms for 65 mA limit.

C3 and C4 are only used if needed to eliminate triggering of SCR by transients, use minimum value possible.

sistors in parallel and let each one handle about 5 or 6 A. You must also consider power dissipation, and adequate heat sinking is required. A single 2N3055 for Q1 requires about 17-mA drive for a 0.5-A output and about 100-mA drive for a 2-A load on Q1. As you can see, the 723 regulator's output capacity can be quickly exceeded just to drive a single-pass transistor.

safely loading the regulator

A good way to handle the required drive to the pass transistor without overloading the 723 regulator is to use a "Darlington pair". **Figure 2** shows Q2 and Q3 in a Darlington configuration. Q2 is the driver for Q3. I didn't show a Q1 in this diagram because I want you to think of Q1 as being mounted on the voltage regulator circuit board. With the high gain of the Darlington pair, the drive to Q2 from the 723 regulator is only 0.7 mA for a 2-A load and 1.5 mA for a 3-A load. The 723 regulator is now barely loafing.

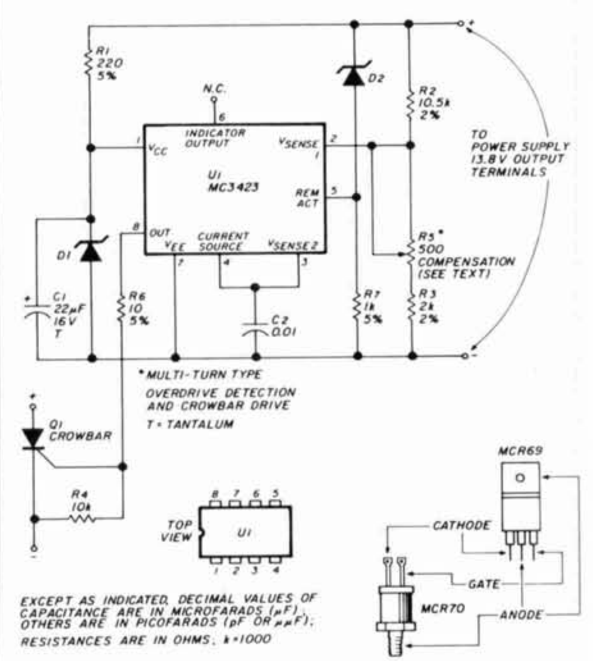
Now let's look at a "super duty" current, maybe 30 A. **Figure 3** shows a circuit with two drivers and three or more pass transistors (Q3, Q4, and Q5). The 0.1-ohm 5-watt emitter resistors are important because they make the multiple pass transistors share the load. The 22-ohm resistor attached to the base of each pass transistor also helps equalize load, but these resistors are not absolutely necessary.

Another important design feature is the overvoltage protection or "crowbar". A crowbar is typically a circuit which detects voltage exceeding a fixed value and fires an SCR to short circuit the input supply to the regulator circuit and blow a fuse. The term crowbar probably comes from the use of brute force to blow

the fuse and stop the overvoltage condition. Don't try to blow a 35-A fuse with a 6-A SCR!

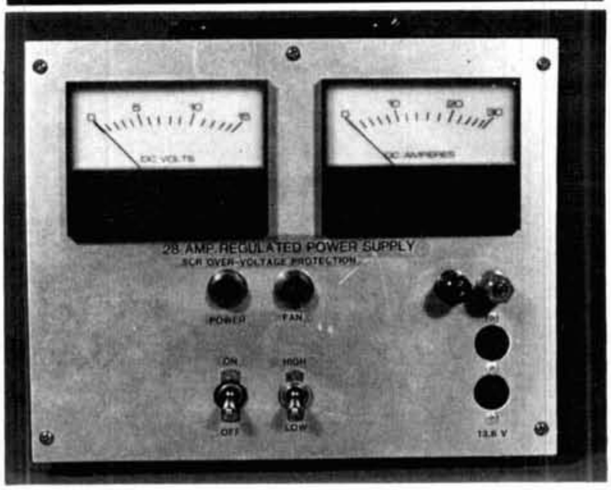
A common crowbar circuit is shown in **fig. 4**. Capacitors C3 and C4 help prevent false triggering of the SCR by transients and spikes. But it's really not false triggering at all; the crowbar is doing exactly what it is supposed to do. If you connect an oscilloscope to the output of your power supply and turn the power switch off and on a few times, I think you may be surprised at the spikes. These spikes are a real nuisance and can be very difficult to suppress.

FIGURE 5



Overvoltage circuit[1] using the MC3423 overvoltage sensor.

PHOTO B



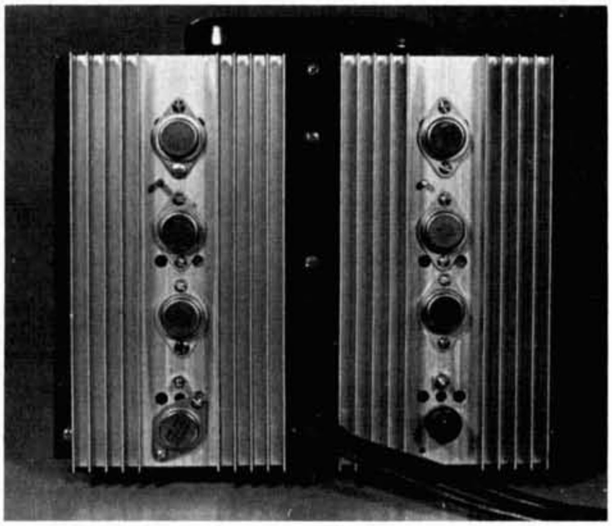
28-A power supply. Note switch for 2-speed fan.

An excellent article on overvoltage protection using an MC3423 overvoltage sensor specifically designed to fire a crowbar was written by VK5IK.[1] The MC3423 circuit is shown in **fig. 5**.

Photo A shows two mini-boxes on top of the 28-A power supply. These are battery chargers for an HT. The box with the black-faced meter is a NiCd battery charger with two outputs — one with adjustable current and one with fixed output. The bench supply on the lower right has both adjustable voltage and current capability.

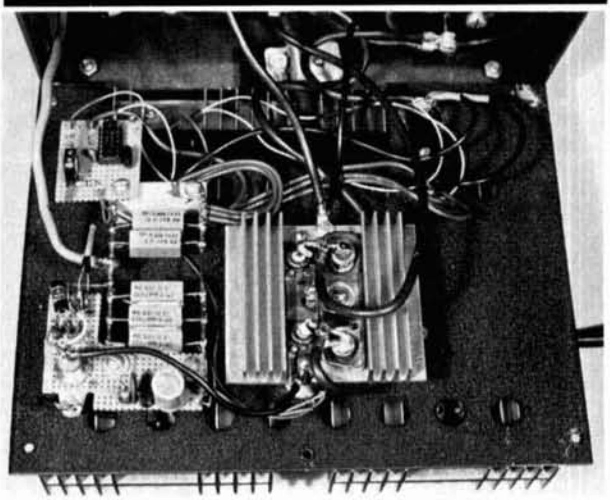
Let's take a closer look at how the 723 voltage regulator is used in some of this equipment. The high ampere power supply in **photos B, C,** and **D** was used

PHOTO C



Back of 28-A power supply. The "driver" is the transistor at the lower left. At the lower right is a 35-A fuse holder. The other six transistors are 2N3055 pass transistors.

PHOTO D

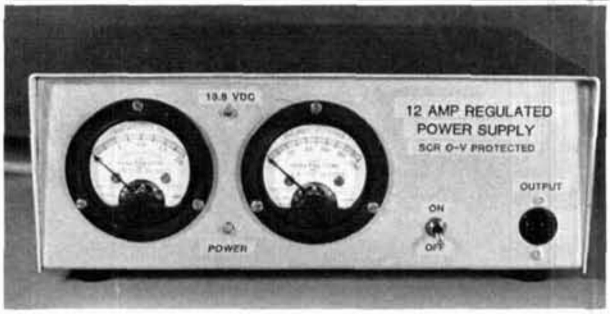


28-A power supply wiring. Voltage regulator board is at upper left. The crowbar is on the separate board at the lower left. Note the five 0.1 ohm 5 watt current limit resistors soldered to the two buss wires.

for several years with my TR7A and several Atlas transceivers. You can keep a two-speed fan on low for any current under 10 A continuous and all SSB operation. The heat-sinked full-wave bridge at the lower right of **photo D** comes from diodes "liberated" from the horseshoe rectifier assembly of a 65-A automotive alternator. These rectifier assemblies contain six diodes and usually only one fails.

My latest power supply is shown in **photo E**. The meters were hamfest specials, both 0-1 mA with shunt or series resistors as needed. This is the first time I have made and used a pc board. I "married" the VK5IK overvoltage circuit to my 723 circuit. To reduce unwanted triggering of the SCR, I found it necessary to increase C2 of the VK5IK circuit to 0.047 μF.

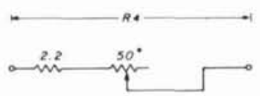
PHOTO E



12 A power supply with "matched" meters for 0-20v and 0-10 A.

The two-output battery charger in **photo A** (box with black meter) uses two separate 723 circuits from the same dc input source. The fixed output is limited by R4 to 15 mA to trickle charge AA NiCds. The voltage is set to perhaps 24 volts, plenty for a dozen or more AA cells at a time. Because the current limit is fixed, it doesn't matter whether one or a dozen AA cells are on trickle charge; no adjustment is necessary. I did place an LED in this output to show when current is flowing — this eliminates the need for a meter.

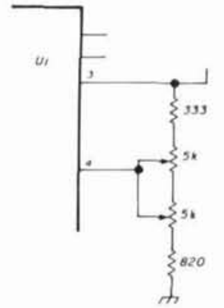
FIGURE 6



Current limit resistor schematic for adjustable current limit of about 10 mA to 1 A.

The second output is current adjustable from about 12 mA to 300 mA by the use of a fixed resistor in series with a potentiometer (**fig. 6**). Again the voltage is set high enough to charge a large number of cells at one time. The charge rate remains constant until you change the adjustment.

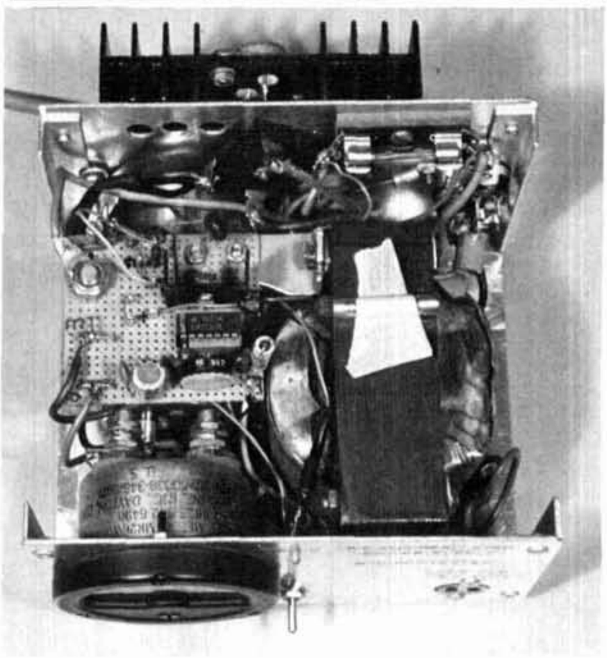
FIGURE 7



Two potentiometers provided little benefit to reduce minimum voltage since the lower voltage limit is 7 volts with the 723 circuit used.

The 0 to 1-A bench supply shown at the lower right in **photo A** is another variation of the battery charger described above, with R2 mounted on the front panel for convenient voltage adjustment. (Well, that's almost how I did it!) I found that the minimum voltage adjustment using the 5k pot with the 1k resistors (R1 and R3) was just under 8 volts. I tried to get the lowest possible voltage and changed R1, R2, and R3 as shown in **fig. 7**. The change didn't do everything I wanted (remember the circuit used for the 723 has a lower limit of 7 volts), but because I had already added the second potentiometer to the panel I didn't change it. Replacing the 2.2-ohm resistor in **fig. 6** with a 0.65-ohm 1-watt resistor (actually a couple of resistors in

PHOTO F



Battery charger for HT uses voltage doubler on left half with 723 circuit on right half.

(continued on page 51)

DAYTON Hamvention®

April 28, 29, 30, 1989

Early Reservation Information

· General Chairman, Bill McNabb, WD8SAY · Asst. General Chairman, Ed Hillman, N8ALN

- **Giant 3 day flea market • Exhibits**
- **License exams • Free bus service**
- **CW proficiency test • Door prizes**

Flea market tickets and grand banquet tickets are limited. Place your reservations early, please.

Flea Market Tickets
A maximum of 3 spaces per person (non-transferable). Tickets (valid all 3 days) will be sold IN ADVANCE ONLY. No spaces sold at gate. Vendors MUST order registration ticket when ordering flea market spaces.

Special Awards
Nominations are requested for 'Radio Amateur of the Year,' 'Special Achievement' and 'Technical Achievement' awards. Contact: Hamvention Awards Chairman, Box 964, Dayton, OH 45401.

License Exams
Novice thru Extra exams scheduled Saturday and Sunday by appointment only. Send FCC form 610 (Aug. 1985 or later) - with requested elements shown at top of form, copy of present license and check for prevailing ARRL rates (payable to ARRL/VEC) to: Exam Registration, 8830 Windbluff Point, Dayton, OH 45458

1989 Deadlines
Award Nominations: March 15
Lodging: April 7
License Exams: March 26
Advance Registration and banquet:
USA - April 4 Canada - March 31
Flea Market Space:
Spaces will be allocated by the Hamvention committee from all orders recieved prior to February 1. Express Mail *NOT* be necessary! Notification of space assignment will be mailed by March 15, 1989.

Information
General Information: (513) 433-7720
or, Box 2205, Dayton, OH 45401
Lodging Information: (513) 223-2612
(No Reservations By Phone)

Lodging
Please write to **Lodging, Dayton Hamvention, Chamber Plaza, 5th & Main Streets, Dayton, OH 45402** or refer to our 1988 Hamvention program for lodging information which includes a listing of hotel/motels located in the surrounding areas of Dayton. Reservations for the surrounding area will then become the responsibility of the individual.

HAMVENTION is sponsored by the Dayton Amateur Radio Association Inc.

Advance Registration Form

Dayton Hamvention 1989
Reservation Deadline – USA-April 4, Canada-March 31
Flea Market Reservation Deadline: February 1

Enclose check or money order for amount indicated and send a self addressed stamped envelope.

Please Type or Print your Name and Address clearly.

	How Many		
Admission (valid all 3 days)	______	@ $10.00*	$______
Grand Banquet	______	@ $20.00**	$______
Women's Luncheon			
(Saturday)	______	@ $7.00	$______
(Sunday)	______	@ $7.00	$______
Flea Market	______	$25/1 space	
(Max. 3 spaces)		$50/2 adjacent	
Admission ticket must be ordered with flea market tickets		$150/3 adjacent	$______
		Total	$______

* $12.00 at door ** $22.00 at door, if available

Name ____________________
Address ____________________
City ____________ State ______ Zip ______

Make checks payable to – **Dayton HAMVENTION**

Mail to – **Dayton Hamvention**
Box 2205
Dayton, OH 45401

Wide Dynamic Range and Low Distortion — The Key to Superior HF Data Communications

- Dynamic Range > 75 dB
- 400 to 4000 Hz
- BW Matched to Baud Rate
- BER < 1×10^{-5} for S / N = 0 dB
- 10 to 1200 Baud
- Linear Phase Filters

ST-8000 HF Modem

Real HF radio teleprinter signals exhibit heavy fading and distortion, requirements that cannot be measured by standard constant amplitude BER and distortion test procedures. In designing the ST-8000, HAL has gone the extra step beyond traditional test and design. Our noise floor is at -65 dBm, not at -30 dBm as on other units, an extra 35 dB gain margin to handle fading. Filters in the ST-8000 are all of linear-phase design to give minimum pulse distortion, not sharp-skirted filters with high phase distortion. All signal processing is done at the input tone frequency; heterodyning is NOT used. This avoids distortion due to frequency conversion or introduced by abnormally high or low filter Q's. Bandwidths of the input, Mark/Space channels, and post-detection filters are all computed and set for the baud rate you select, from 10 to 1200 baud. Other standard features of the ST-8000 include:

- 8 Programmable Memories
- Set frequencies in 1 Hz steps
- Adjustable Print Squelch
- Phase-continuous TX Tones
- Split or Transceive TX/RX
- CRT Tuning Indicator
- RS-232C, MIL-188C, or TTL Data
- 8, 600, or 10K Audio Input
- Signal Regeneration
- Variable Threshold Diversity
- RS-232 Remote Control I/O
- 100-130/200-250 VAC, 44-440 Hz
- AM or FM Signal Processing
- 32 steps of M/S filter BW
- Mark or Space-Only Detection
- Digital Multipath Correction
- FDX or HDX with Echo
- Spectra-Tune and X-Y Display
- Transmitter PTT Relay
- 8 or 600 Ohm Audio Output
- Code and Speed Conversion
- Signal Amplitude Squelch
- Receive Clock Recovery
- 3.5" High Rack Mounting

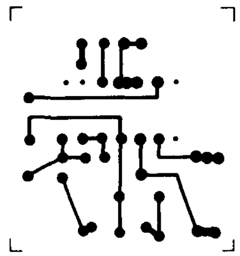
Write or call for complete ST-8000 specifications.

HAL Communications Corp.
Government Products Division
Post Office Box 365
Urbana, Illinois 61801
(217) 367-7373 TWX 910-245-0784

✓ 179

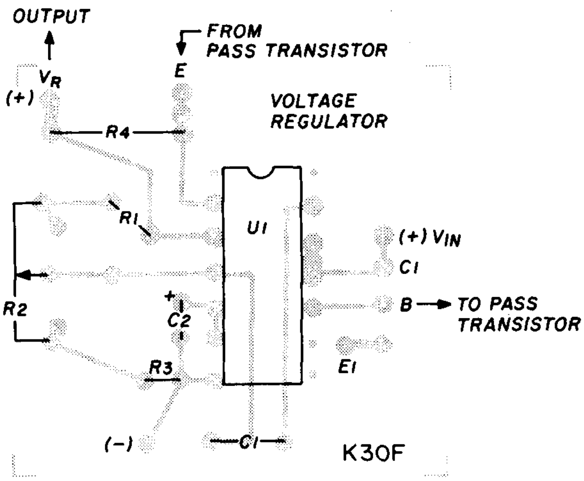
(continued from page 46)

FIGURE 8



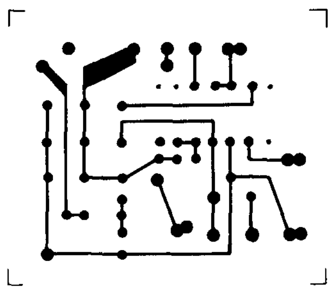
Foil side of the basic 723 regulator PC board (actual size).

FIGURE 9



Component side of the basic 723 regulator PCB showing component location (enlarged view).

FIGURE 10

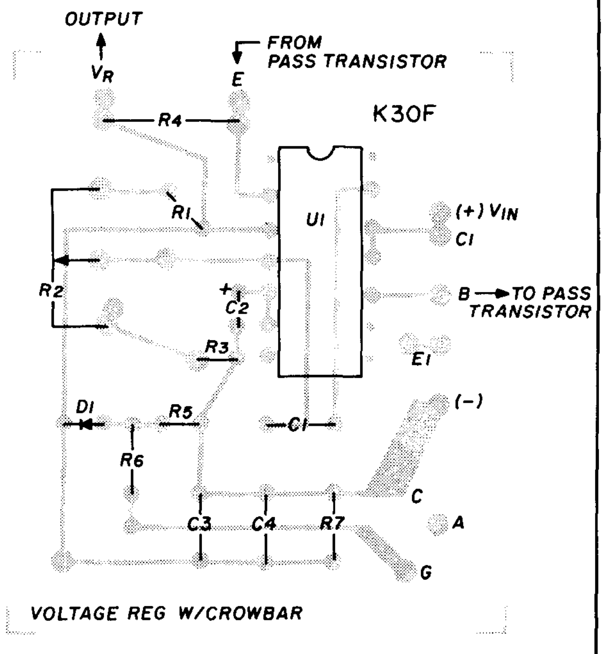


Foil side of the 723 regulator PCB with "crowbar" circuit added (actual size).

parallel) allowed me to attain the 1-A current limit. I use this bench supply primarily as a battery charger.

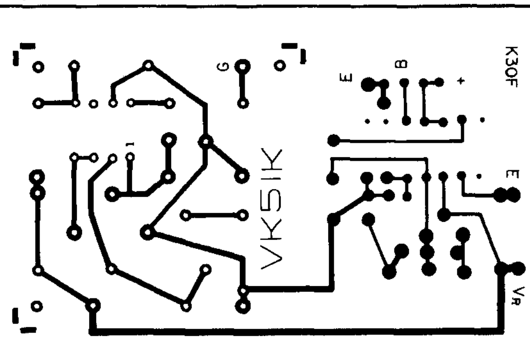
I then made a battery charger for an HT (**photo F**) which will both quick and trickle charge. I selected R4 to limit the current to 150 mA (I have also used 450-mA limit). I adjust the voltage with a fully charged battery pack and a milliammeter in the circuit so that the charger will float across the battery pack at 15 mA. I even keep the charger connected while using the HT. The quick charge is not quite as good as more sophisticated circuits which maintain a maximum rate until a set point and then switch to the low rate. The 723 circuit starts out at maximum charge but tapers off as the voltage of the battery pack increases with the level of charge. The quick charge is effective to about 60 percent of full charge before it passes through a normal rate and finally to the 15 mA trickle rate. It's not

FIGURE 11



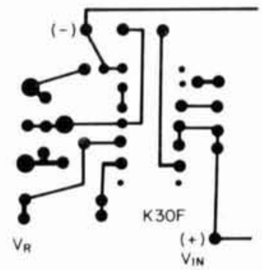
Component side of the 723 regulator PCB with "crowbar" showing component placement (enlarged view).

FIGURE 12



Foil side of the basic 723 regulator circuit "married" to the VK5IK overvoltage protection circuit (actual size).

FIGURE 13



Foil side of multiple 723 regulator circuits for multiple voltages and/or current limits (actual size).

fancy but it sure beats the charger supplied with the HT.

The charger in **photo F** has a voltage doubler. It was originally built to use with a TR2400 with an 8-cell battery pack. I used the charger in the car, but found that the car's electrical system voltage wasn't high enough to charge the HT battery pack unless the motor was running and the car's voltage was about 14.1 volts. I added the voltage doubler circuit[2] and it solved the charge problem. But this little device puts out a lot of RFI. It seems to be a broad-banded frequency sweeping RFI on any hf frequency. I'm not sure how it would work if enclosed in a shielded minibox.

I built another HT battery charger without the voltage doubler for use in the shack. I now have an HT with a 7-cell battery pack so I can use the car's electrical system, a 13.8-volt power supply, or a wall-type dc module.

I have included several circuit board designs. **Figure 8** is the basic 723 voltage regulator circuit. The component side is shown in **fig. 9**. The pc board has provision for the on-board driver. If the driver is mounted on the board, E1 (not B) goes to the base of the pass transistor or the second driver. The collector voltage to the on-board drive is supplied by C1. The same pc board is shown in **fig. 10** with a conventional crowbar circuit added; **figure 11** shows the component side. A 4 to 6-A SCR can be mounted directly on the board, but SCRs for higher current applications should be mounted remotely (no heat sink required) and R7 connected directly to the SCR.

Figure 12 shows the 723 circuit "married" to the VK5IK circuit. **Figure 13** has multiple 723 circuits from a common supply so you can have multiple outputs and charge NiCds or gel-cells from the same supply simultaneously.

references

1. Ian N. Cousins, VK5IK, "Overvoltage Protection for 13.8v Power Supplies," *QST*, October 1983, pages 37-40.
2. *Radio Amateur Handbook*, 1981, American Radio Relay League, page 10-5.

bibliography

1. Paul J. Dujnich, WA3TLD "Power Supply Regulation — using common sense," *73 Magazine*, January 1978, page 140.
2. Bob Engle, K9QLL, "Cheap Power Ploy," *73 Magazine*, August 1984, page 10.
3. Joseph J. Carr, K4IPV, "A Power Supply Primer: Part I, *73 Magazine*, November 1986, page 26.
4. Doug DeMaw, W1FB, "Some Power Supply Design Basics," *QST*, January 1987, page 26.

Article G **HAM RADIO**

THE WEEKENDER

DTMF group call decoder

With frequency congestion becoming a problem in certain areas, the use of selective decoders is increasingly popular and in some places very nearly a necessity. Although some manufacturers include these devices in their new equipment, many hams use older equipment not yet ready for retirement.

Circuit description: Power supply

DC voltage enters through L1, which is used to filter power supply noise. Regulator Q1 steps down the voltage to the required +5 Vdc. The voltage is then filtered by C1 and C2. (See **fig. 1** for the complete circuit.)

DTMF decoder

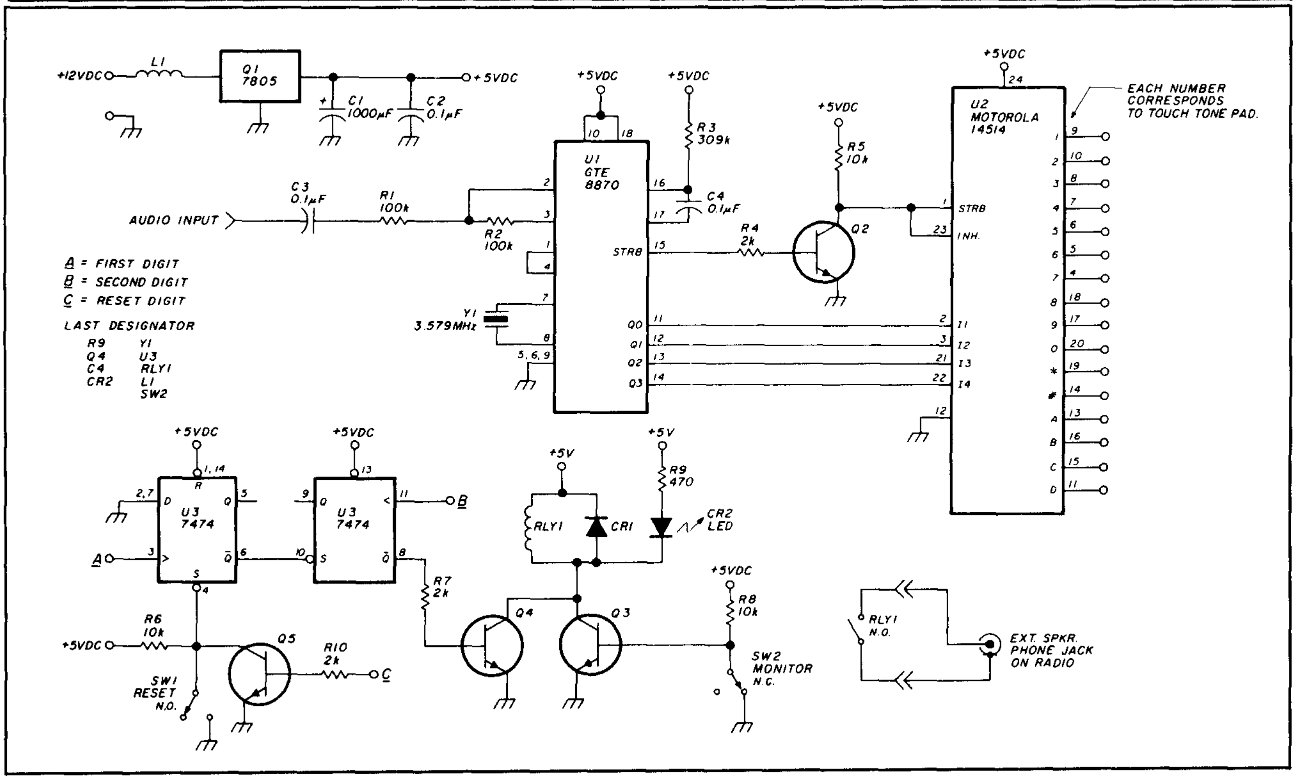
The audio tone signal enters through C3 to the summing amplifier in U1. Network R3 and C4 determine valid tone detection time. A positive-going strobe pulse is presented on pin 15 every time a valid DTMF code is received. Components R4, R5, and Q2 invert this signal designation to U2, indicating that the 4-bit decoded signal is present on Q0 through Q3.

4 to 16 multiplexer

After U2 receives a strobe from U1, it takes the code and puts a high-going pulse on the decoded output. If you use a 4×4 DTMF keypad, all 16 outputs are active. If you choose a 3×4 keypad, only outputs 1-0, *, and # are active.

By Roger Owens, AA4NX, 2042 Old Big Cove Road, Owens Cross Roads, Alabama 35763

FIGURE 1



Schematic of the DTMF decoder and related circuitry.

PARTS LIST

C1	1000μF 35 volt	Electrolytic cap
C2,C3,C4	0.1μF 50 volt	CER capacitor
CR1	IN4148	General purpose diode
CR2	TI3/4	LED green
L1	(as needed)	Inductor
Q1	7805	+5 volt regulator
Q2-4	2N3904	NPN transistor
R1,R2	100 k	1/8 watt 1 percent
R3	309 k	1/8 watt 1 percent
R4,R7	2 k	1/8 watt 1 percent
R5,R6,R8	10 k	1/8 watt 1 percent
R9	470 ohm	1/8 watt 1 percent
RLY1	IA05	+5 volt relay
SW1	Normally open	Push button-momentary
SW2	Normally closed	Push button-momentary
U1	GTE 8870	DTMF decoder
U2	Motorola MC14514A	4 to 16 decoder
U3	74LS74	D type flip-flop
Y1	3.57 MHz	Color burst crystal

Decoder

There are two inputs applied to U3 — A and B. Input A is connected to the U2 decoded output used for the first digit. Conversely, input B is connected for the second decoded digit.

Once input A receives a positive going pulse, U3 pin 6 goes high allowing input B to be accepted; this is the second decode digit. U3 is arranged so the 2-digit signal must be entered in the correct sequence. Once this is done a signal is applied through R7 to the base of Q4, turning it on, pulling in relay 1, and closing the audio path. Diode CR1 protects the circuit from relay 1 CEMF.

When Q4 turns on, LED CR2 comes on indicating reception of a valid sequence. Resistor R9 limits the current through CR2 to about 10 mA.

Reset

Once the relay is closed by a valid sequence, it's deactivated by pushing the reset button or by connecting input C to a selected decoded output. Either of these resets pulls U3 (SET) low causing relay 1 to open, breaking the audio path.

Monitor

If you wish to monitor the frequency, open the monitor switch. This lets Q3 turn on closing relay 1. Closing this switch squelches the audio again.

Ordering information

You can order printed circuit boards for $15.00 each from: Valley Communications, P.O. Box 277, Owens Cross Roads, Alabama 35763.

Article H **HAM RADIO**

KAM
Kantronics All Mode
Kantronics KPC-4 DUAL PORT COMMUNICATOR
KPC-2 PACKET COMMUNICATOR II
Kantronics
RF PACKET MODEM
Kantronics
KPC-2400
Kantronics


WORLDWIDE DISTRIBUTION
HAM RADIO OUTLET
GUARANTEED QUALITY AT COMPETITIVE PRICES
LARGEST HAM OUTLET IN THE WORLD
7 STORE BUYING POWER
GEOCHRON
GLOBAL TIME INDICATOR
SALE
• Detailed illuminated map shows time, time zone, sun position and day of the week at a glance for any place in the world.
• Continuously moving - areas of day and night change as you watch.
• Mounts easily on a wall. Size: 34½"x22½".
$1295 $1159.95 DELIVERED IN U.S.
A3 DX THAT STANDS OUT FROM THE CROWD
10, 15, 20 Meters
cushcraft
Whether busting pileups, rag chewing or hunting rare DX, the A3 stands out from the crowd with the perfect combination of easy assembly, the right size, rugged durability and great performance.
• Boom Length 14 ft., Weight 27 lbs.
• Wind Surface Area 4.36 ft.
Mast not included
REG. 319.95
SALE 249.95
Plus Shipping
SALE
rf concepts
VHF/UHF SOLIDSTATE AMPLIFIERS
Contemporary design, quality and a 5 year warranty on parts and labor.
6 months on the RF Final transistors.
All amplifiers have GaAsFET receive pre-amps and high SWR shutdown protection.
US TOWER CORPORATION
MA-40
40' TUBULAR TOWER
$809 SALE! $629
MA-550
55' TUBULAR TOWER
$1369 SALE! $999
• Handles 10 sq. ft. at 50 mph
• Pleases neighbors with tubular streamlined look
TX-455
55' FREESTANDING CRANK-UP
• Handles 18 sq. ft. at 50 mph
• No guying required
• Extra-strength Construction
• Can add raising and motor drive accessories
Shown with optional MARB rotor base
TOWERS RATED TO EIA SPECIFICATIONS
OTHER MODELS AT GREAT PRICES
IN STOCK FOR QUICK DELIVERY
TEN-TEC
MADE IN USA
PARAGON 585
• Ten-Tec QSK cw, real FSK and sideband audio
• Select any filter in any mode
• TX 160 through 10 meters • All mode superiority
• RX 100 kHz to 30MHz • A premier HF rig
TITAN 425
• Pair 3CX800A7 • External Power Supply
• Performance at legal limit
• 3 MS QSK, 1.6 to 22 MHz • Assures "Loaf Along"
• With authorized modification through 29.999 MHz
IN STOCK NOW! FREE SHIPMENT!
AEA Advanced Electronic Applications
PK-232 Multi-mode Data Controller
• NEW IBM Fax Screen Display Program Available
• Transmit/Receive on Six Modes
• CW/RTTY/ASCII/ AMTOR/Packet/FAX
• IBM and Commodore terminal programs available
• Radio Ports for HF and VHF
In Stock for Quick Delivery
Free Shipment
KENWOOD
TM-721A DUAL BANDER
2 MTR/70cm
45w 35w
EXTENDED RECEIVING RANGE (2MTR)
TM-621A DUAL BANDER
2 MTR/220MHz
45w 25w
AUTOMATIC OFFSET
CALL FOR LOW, LOW PRICE
FREE SHIPMENT Most items UPS surface
All Major Brands in Stock Now!
OUTSIDE CALIFORNIA CALL TOLL FREE (800) 854-6046
INSIDE CALIFORNIA CALL STORES DIRECT
Toll free including Hawaii, Phone Hrs: 7:00 am to 5:30 pm Pacific Time, California, Arizona and Georgia customers call or visit nearest store.
California, Arizona and Georgia residents please add sales tax. Prices, specifications, descriptions subject to change without notice.
MasterCard
VISA

ELECTRO-BRAILLE TRANSDUCERS
AND THEIR APPLICATION

By G. W. Horn, I4MK, 17, via Pio IX, 40017 S. Giovanni Persiceto, Bologna, Italy

Almost all digital read-out devices rely on the user's eyesight. LEDs, LCDs, and other digital displays are useless to blind operators. Acquiring data in a usable form is an obstacle that has plagued the sightless ham since the earliest days of wireless.

It's true that digital data (from a DVM or a counter, for instance) may be "spoken" by a voice synthesizer, but such designs are often cumbersome to use. Data can also be "written" on a row of tactile sensors coded in Braille. The second solution is better because the displayed data is "frozen" into the tactile sensors to be read and reread at will, without the uncertainty of synthetic speech. Written information is usually more precise and immediate than spoken.

Because many blind people read Braille, a read-out device that converts electrical voltages to a mechanical Braille format seemed ideal to me.

For those not familiar with the system, Braille characters are formed on a six-dot matrix (see **fig. 1**). The presence or absence of an embossed dot at each of the six crosspoints determines the "value" or meaning of that character. These dots are conventionally called P1, P2, P3, P4, P5, and P6. The figures from 0 to 9 are represented by points P1, P2, P4, and P5; the sign is given by the four points P2, P3, P5, and P6; and the letters are made by combinations of all six points. If you assign a bit sequence (dot = 1, no dot = 0) to the six dots, you can consider Braille a true digital code.

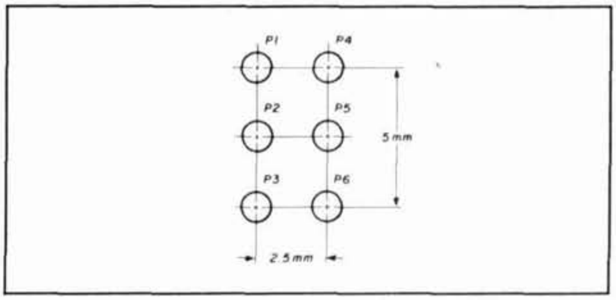
You can convert alphanumeric information of digital origin into Braille using "tactile" or electro-Braille transducers. There are two main types:

- **Vibrating.** These tranducers consist of thin piezoceramic reeds, like those of some reading machines. Among these are the optacon.[1,2]
- **Electromechanical on/off.** These are usually employed in telephone exchanges attended by blind operators.

Electromechanical transducers have six pins arranged according to the standard Braille pattern shown in **fig. 1**. The pins are raised from the "no dot" level (0) to the "dot" level (1) by means of suction solenoids. They can be classified by operating mode as mono- or bistable electro-Braille transducers.

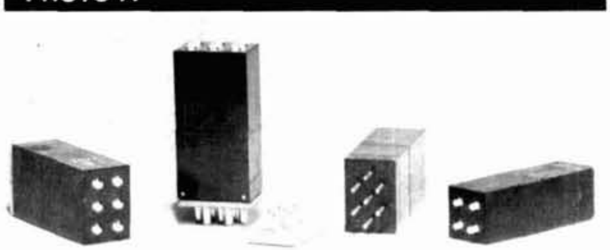
The pins of the monostable transducer (the simplest to construct) in **photo A** go up when the related solenoids are energized and remain up until enough current flows into the solenoids. There is a problem, however. The lack of a mechanical latch means that the pin raised at logical 1 can be pushed down by fingertip pressure. A further drawback is the dimension of

FIGURE 1



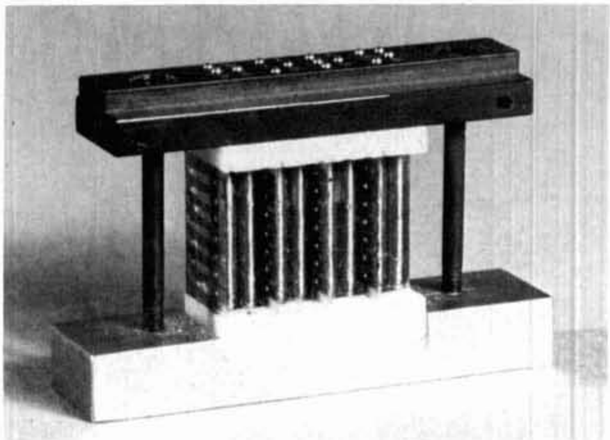
Standard Braille matrix.

PHOTO A



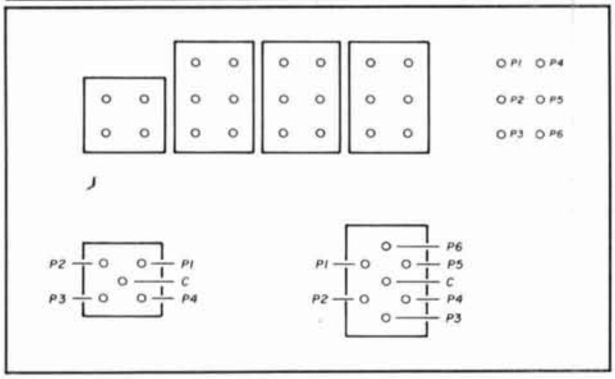
Four and six-dot monostable electro-Braille transducers (manufactured by Tiflotel).

PHOTO B



Bistable electro-Braille transducers arranged in a row of four (manufactured by Tiflotel).

FIGURE 2



Reading row of three monostable and one polarity transducer.

this transducer's matrix; it's slightly larger than standard Braille.

The bistable transducer in **photo B** has a mechanism that latches the pin into the position where the control pulse has driven it previously. Consequently, a pin is raised at 1 when a short current pulse is applied to its solenoid. A similar pulse of opposite polarity will bring it to 0 again.[3,4]

In another version, each pin is driven by two independent solenoids — one for raising (write), and a second for lowering (erase). Both are controlled by pulses of the same polarity.

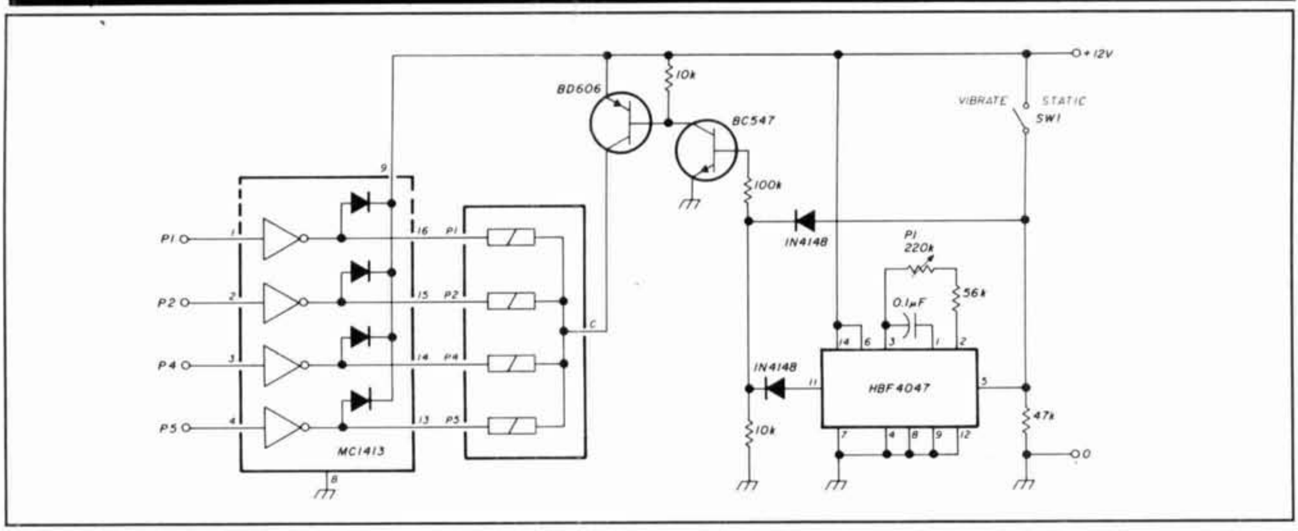
The main advantage of the bistable transducer is that the pin, once at 1, can't recede under fingertip pressure because of the mechanical latch. Another advantage is that the transducer is pulse energized. Power drain and consequent heating are also reduced to a minimum in this device. Bistable transducers, whose matrices reproduce Braille's dimensions exactly, are generally assembled into a block or row of four (or n × 4).

Because of their dissimilar internal structures, mono- and bistable transducers need different kinds of electrical drive — static (DC) and dynamic (pulses).

The typical monostable transducer (shown in **photo A**), drains about 50 mA per pin at +12 volts. The peripheral driver array MC 1413 (ULN 2003) is a suitable driver for its four or six pins. The seven Darlington pairs of this chip can supply the required current and are intrinsically protected against inductive voltage spikes.

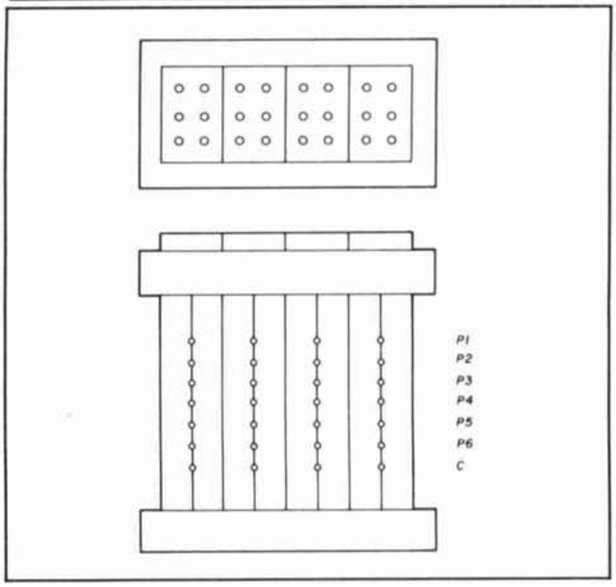
Translation of the BCD data coming from a three-digit DVM (a CA 3162E, for instance) into Braille requires a row of three-figure and one-polarity trans-

FIGURE 3



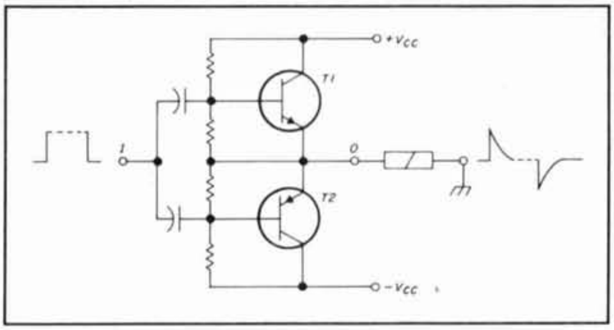
Vibrating-mode drive of four-dot monostable transducers. Vibration frequency is controlled by P1.

FIGURE 4



Reading row of four bistable two-phase electro-Braille transducers.

FIGURE 5



Low output impedance differentiating driver.

ducers (see **fig. 2**). If you use monostable transducers, remember that Braille numerals consist of four dots (at maximum), the operational signs have three dots, and the decimal point (DP) is conventionally indicated by point P3 of each transducer. This means there are a total of 18 solenoids to be driven (at a maximum DC current of approximately 1 A), requiring three ULN 2003 driver ICs.

Power drain and heating can be reduced considerably by supplying the transducer row with a square wave (see **fig. 3**) instead of a DC current, which lets the pins vibrate. The resulting sensation makes reading easier and relieves the uncertainties caused by the tendency of the pins to recede under fingertip pressure.

The bistable transducer's solenoids (shown in **photo B**) are controlled by short two-phase pulses.

BATTERIES "R" US...

You've bought our replacement batteries before...
NOW YOU CAN BUY DIRECT FROM US, THE MANUFACTURER!

ICOM
CM2, PB2 7.2v @ 500MAH
CM5, PB5 10.8v @ 500MAH
SUPER 7S & 8S
13.2v @ 1100MAH
9.6v @ 1200MAH
(base charge only)
Introductory Offer!
SUPER 7S & 8S - $64.95 each

KENWOOD
KNB-1 10.8v @ 500MAH
KNB-4 7.2v @ 2000MAH
KNB-5 12v @ 1000MAH
PB-1 12v @ 1000MAH

YAESU/MAXON
*FNB-10 7.2v @ 600MAH
FNB-12 12v @ 500MAH
*FNB-10(S) 7.2v @ 1000MAH
*same size case as FNB-12

Introductory Offer!
P4W 11v @ 500MAH - $22.63
FNB-2 11v @ 500MAH - $22.63

CUSTOM MADE BATTERY PACKS & INSERTS
Made to your specifications.
Introductory Offer!
KENWOOD
PB-25—$20.00; BP-5—$23.00
BP-3—$18.95
ICOM
BP-5—$23.00; BP-3—$18.95

Prices subject to change without notice.

MasterCard and Visa cards accepted. NYS residents add 8¼% sales tax. Add $3.00 for postage and handling.

1 SOURCE FOR ALL YOUR COMMUNICATION BATTERY REPLACEMENT NEEDS.

W & W ASSOCIATES

29-11 Parsons Boulevard, Flushing, N.Y. 11354

OUR PRICES CAN'T BE BEAT!

SEND FOR **FREE** CATALOG & PRICE LIST!

WORLD WIDE DISTRIBUTORSHIPS AVAILABLE. PLEASE INQUIRE.

SEE US AT DAYTON!

In U.S. & Canada Call Toll Free (800) 221-0732 • IN NYS (718) 961-2103 • Telex: 51060 16795 • FAX: (718) 461-1978

✓ 182

antenneX©

"The Magazine For Antenna Experimenters"

IF YOU -

- Have a lousy mobile signal on all bands?
- Need an inexpensive beam for 10 meters?
- Unsure about using vert vs horiz antenna?
- Need a low noise antenna for 160 meters?
- Want to design an antenna just for you?
- Need a program for design and plotting?
- Need to solve a unique problem?
- Know the best antenna for hamsats,etc.?
- Need a disguised mobile antenna?
- Want a cheap automatic coupler system?
- Just want to learn more about antennas?

THEN SUBSCRIBE TO - *antenneX©*

12 MONTHLY ISSUES is only $11.97 for USA and possessions. $17.00 foreign.

antenneX©

P.O. Box 8995 Dept. 19
Corpus Christi, TX 78412

✓ 183

Iron Powder and Ferrite

TOROIDAL CORES

Shielding Beads, Shielded Coil Forms
Ferrite Rods, Pot Cores, Baluns, Etc.

Small Orders Welcome
Free 'Tech-Data' Flyer

AMIDON Associates **Since 1963**

12033 Otsego Street, North Hollywood, Calif. 91607

✓ 184

NEW NEW NEW

PLENTY OF BOOKS LISTED IN THE BOOKSTORE'S CATALOG—
SAVE TIME AND MONEY.
SHOP BY MAIL FROM YOUR #1 SOURCE OF AMATEUR BOOKS AND SOFTWARE.

HAM RADIO'S BOOKSTORE GREENVILLE, NH 03048
(603) 878-1441

INTERFERENCE?

★ Interference Location
★ Stuck Microphones
★ Cable TV Leaks
★ Security Monitoring

★ VHF and UHF Coverage
★ Computer Interface
★ Speech Synthesizer
★ 12 VDC Operation

New Technology (patent pending) converts any VHF or UHF FM receiver into an advanced Doppler shift radio direction finder. Simply plug into receiver's antenna and external speaker jacks. Uses four omnidirectional antennas. Low noise, high sensitivity for weak signal detection. Call or write for full details and prices.

DOPPLER SYSTEMS, INC. P.O. Box 31819
Phoenix, AZ 85046 (602) 488-9755

✓ 185

A + 12 volt, 20-mS pulse makes the pin rise at logical 1; another − 12 volt, 10-mS pulse resets it to logical 0 (coil resistance 65 ohms, inductance 15 mH). **Figure 4** shows schematically a reading row of four of these types of transducers.

Control pulses are delivered to the solenoid by a low-impedance driver capable of supplying enough current in both directions. It may consist of a couple of complementary transistors arranged in a mirror emitter-follower configuration (see **fig. 5**). This can be implemented with a single dual NPN/PNP transistor like the BFX 79.

The data to be read should be saved into suitable registers, independent from transducer's type and accompanying driver circuit. The input data from a DVM, for example, is mostly multiplexed. A quad-latch register, like the MC 14042, may be used in this instance (see **fig. 6**).

If the transducers are monostable, their driving Darlington will be controlled directly by the Q's of their respective latches. If they are bistable, the Q outputs must be differentiated to get to a positive driving pulse at their rise to 1, and to a negative one at their fall to 0.

Because transducer reading occurs in Braille, the information brought into the relevant register must be translated correspondingly. In the case of BCD data coming from DVM, DMM, ADC, and counters, the Braille translation must be made according to **table 1**.

The fundamental difference between the two codes is that in Braille, contrary to BCD, 0 isn't represented by a sequence of all-null bits. A Braille 0000 sequence would be meaningless indeed!

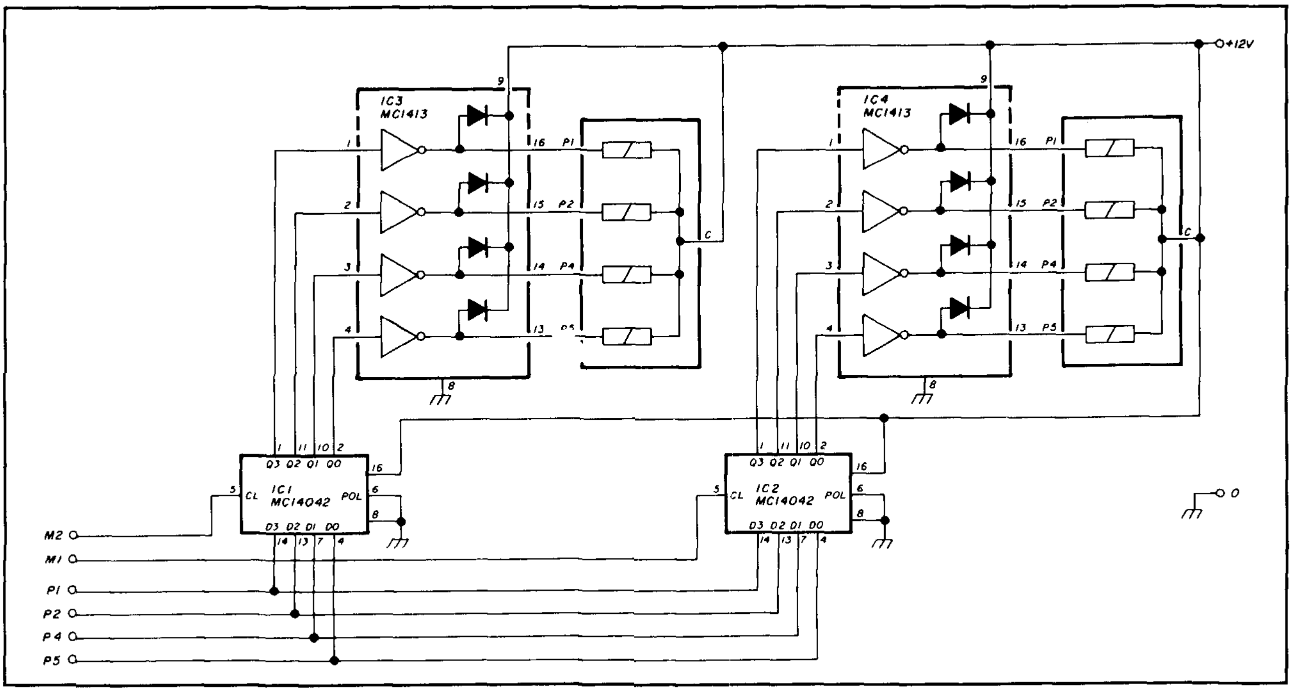
Code conversion can be done by splitting the relevant process into two phases: BCD-to-decimal and decimal-to-Braille conversion. The only BCD-to-decimal decoder that can be used in this way is the MC 14028 which, compared with the more common 4028, doesn't decode the invalid sequences. This feature is of paramount importance when data to be translated into Braille are delivered by a DVM like the CA 3162E. Overflow, polarity reverse, and other situations are given by bit combinations corresponding to

TABLE 1

Braille translation

N	BCD				Braille					
	D	C	B	A	P1	P2	P3	P4	P5	P6
0	0	0	0	0	0	1	0	1	1	0
1	0	0	0	1	1	0	0	0	0	0
2	0	0	1	0	1	1	0	0	0	0
3	0	0	1	1	1	0	0	1	0	0
4	0	1	0	0	1	0	0	1	1	0
5	0	1	0	1	1	0	0	0	1	0
6	0	1	1	0	1	1	0	1	0	0
7	0	1	1	1	1	1	0	1	1	0
8	1	0	0	0	0	1	0	1	1	0
9	1	0	0	1	1	1	0	1	0	0
+	—				0	1	0	1	1	0
−	—				0	1	1	0	0	0

FIGURE 6



Multiplexed two-digit Braille data stored in quad latches provides control of the two four-dot monostable transducers.

It's a lesson you learn very early in life. Many can be good, some may be better, but only one can be the best. The PK-232 is the best multi-mode data controller you can buy.

1 Versatility

The PK-232 should be listed in the amateur radio dictionary under the word Versatile. One data controller that can transmit and receive in six digital modes, and can be used with almost every computer or data terminal. You can even monitor Navtex, the new marine weather and navigational system. Don't forget two radio ports for both VHF and HF, and a no compromise VHF/HF/CW internal modem with an eight pole bandpass filter followed by a limiter discriminator with automatic threshold control.

The internal decoding program (SIAM[tm]) feature can even identify different types of signals for you, including some simple types of RTTY encryption. The only software your computer needs is a terminal program.

PC Pakratt Packet TX/RX Display

Facsimile Screen Display

2 Software Support

While you can use most modem or communications programs with the PK-232, AEA has two very special packages available exclusively for the PK-232....PC Pakratt with Fax for IBM PC and compatible computers, and Com Pakratt with Fax for the Commodore 64 and 128.

Each package includes a terminal program with split screen display, QSO buffer, disk storage of received data, and printer operation, and a second program for transmission/reception and screen display of facsimile signals. The IBM programs are on 5-1/4" disk and the Commodore programs are plug-in ROM cartridges.

3 Proven Winner

No matter what computer or terminal you plan to use, the PK-232 is the best choice for a multi-mode data controller. Over 20,000 amateurs around the world have on-air tested the PK-232 for you. They, along with most major U.S. amateur magazines, have reviewed the PK-232 and found it to be a good value and excellent addition to the ham station.

No other multi-mode controller offers the features and performance of the PK-232. Don't be fooled by imitations. Ask your friends, or call the local amateur radio store. We're confident the PK-232 reputation will convince you that it's time to order your very own PK-232.

Call an authorized AEA dealer today. You deserve the best you can buy, you deserve the PK-232.

Advanced Electronic Applications, Inc.
P.O. Box C-2160
Lynnwood, WA 98036
206-775-7373

AEA Brings you the Breakthrough!

✓ 103

NEWS BULLETIN

CALL US NOW!

YOUR HAM DOLLAR GOES FURTHER AT . . .

CALL OR WRITE FOR SPECIAL QUOTE

When it comes to FAST DELIVERY, HONEST DEALING and PROMPT/DEPENDABLE S-E-R-V-I-C-E back-up We don't just advertise it — WE GIVE IT!

we'll treat you

SELECTION

S-E-R-V-I-C-E

and

SATISFACTION!

Burghardt INC. AMATEUR CENTER

"AMERICA'S MOST RELIABLE AMATEUR RADIO DEALER"

SELL-TRADE

New & Reconditioned

HAM EQUIPMENT

Call or Write Us Today For a Quote! You'll Find Us to be Courteous, Knowledgeable and Honest

PHONE **(605) 886-7314**

FAX **(605) 886-3444**

In 1937, Stan Burghardt (WØIT), because of his intense interest in amateur radio, began selling and servicing amateur radio equipment in conjunction with his radio parts business. We stand proud of this long-lasting tradition of ***Honest Dealing, Quality Products and Dependable "S-E-R-V-I-C-E"!***

Above all, we fully intend to carry on this proud tradition with even more new product lines plus the same ***"fair"*** treatment you've come to rely on. Our reconditioned equipment is of the finest quality with ***30, 60*** and even ***90-day*** parts and labor warranties on selected pieces. ***And always remember:***

— WE SERVICE WHAT WE SELL —

AEA	B&W	Hustler	Nye
Alinco	Belden	Icom	Palomar
Ameco	Bencher	Jerold/Delhi	Radio Callbook
Ameritron	Bird	Kantronics	RF Concepts
Amphenol	Butternut	Kenwood	Rohn
Amp Supply	Centurion	Larsen	Telex/Hygain
Antenna Specialists	CES	MFJ	Ten-Tec
	Cushcraft	Mirage/KLM	Unadilla/Reyco
Astron	Daiwa	Moseley	Yaesu

Write today for our latest Bulletin/Used Equipment List.

STORE HOURS:
9-5 P.M. (CST)
MONDAY thru FRIDAY
OPEN SATURDAYS
from 9-1 P.M. (CST)
CLOSED
SUNDAYS/HOLIDAYS

MAIL AND TELEPHONE ORDERS "WELCOMED" . . . They're our business!!

MasterCard VISA

182 N. Maple
P.O. Box 73
Watertown, SD 57201

IC-781

The Future of Amateur Communications

CALL FOR A QUOTE!

✓ 186

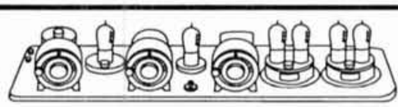
R-7000 Widespan Panadaptor

Panadaptor especially designed for the R-7000 receiver. For use with a standard scope. Variable span width from 1 to 10 Mhz. Uncover unknown elusive signals. Complete with all cables, & 90 day warranty. $349.95 Shipped. Pa. res. add 6%.

GTI Electronics

RD 1 BOX 272
Lehighton, Pa. 18235
717-386-4032

✓ 187



IF YOU BUY, SELL OR COLLECT OLD RADIOS, YOU NEED...

ANTIQUE RADIO CLASSIFIED

Antique Radio's Largest-Circulation Monthly Magazine

FREE SAMPLE COPY!

Classifieds - Ads for Parts & Services
Articles - Auction Prices-Flea Market Info.
Also: Early TV, Ham Equip., Books, Telegraph, Art Deco, 40's & 50's Radios & more...
Free 20-word ad each month. Don't miss out!

6-Month Trial - $11.
1-Year: $19 ($28 by 1st Class)
Foreign by air – Canada: $30; Mexico: $28; Other: $55.

A.R.C., P.O. Box 2-A4, Carlisle, MA 01741

✓ 111

GALLATIN RADIO SUPPLY

Expert repair of Ehrhorn ALPHA 76A, 374A, 78 and 77D series amplifiers.

Also specializing in state-of-the-art repair and modification of the Collins KWM/HF-380 series radios. Latest up-dates available. Factory Authorized. You won't believe the improvement in your radio when it gets back!

Call for more information or to schedule your work.

Gallatin Radio Supply
Attn: Kirby Van Horn
P.O. Box 60064
Houston, Texas 77205
(713) 320-2324

Authorized MADISON Electronics repair facility.

✓ 130

binary figures greater than 9 which, if decoded, would give rise to completely inaccurate numerical indications. Once in decimal, the figure has to be translated into Braille. This can done using the diode matrix shown in **fig. 7**.

It's worth noting that, due to the data structure of many modern digital XCVRs, the actual data is provided in seven-segment format rather than in BCD. In this case, the BCD-to-Braille converter must be preceded by a seven segments-to-BCD one. Such a conversion can be performed[5,6] by the logic shown in **fig. 8**. Inputs coming from segments a, d, e, f, and g are enough. However, the decimal outputs (except N = 0) must be cross wired in order to preserve the correct correspondence between input and output data.

The electro-Braille transducers may be used to read the DVM. **Figure 9** shows a DVM circuit suitable for driving the reading row. One peculiarity of the circuit is the way it generates multiplex pulses M2, M1, and M0. The three AND gates, together with the relevant RC groups, "shape" the pulses in order to suppress spurious signals which would incorrectly trigger the registers.

The TTL digital data delivered by the CA 3162E is then translated by IC3 and IC4 (MC 14504) at MOS level. This is necessary because, to be controlled, the bistable transducers chosen need ±12 volt pulses.

As shown in **fig. 10**, reading row control is performed by three quad latches (MC 14042), followed by three quad-differentiating drivers (DR2, DR1, DR0) which drive the P1, P2, P4, and P5 pins of the figure transducers. The fifth, or quint-differentiating driver (DR ±, DP), controls the P2 P5 (sign −), P2 P3 P5 (sign +) pins of the polarity transducer, and the P3 pins (decimal point DP) of the three-figure ones.

The electrical circuit of the differentiating drivers (DR) is shown in **fig. 11**. The drivers have been simplified without compromising their functionality.

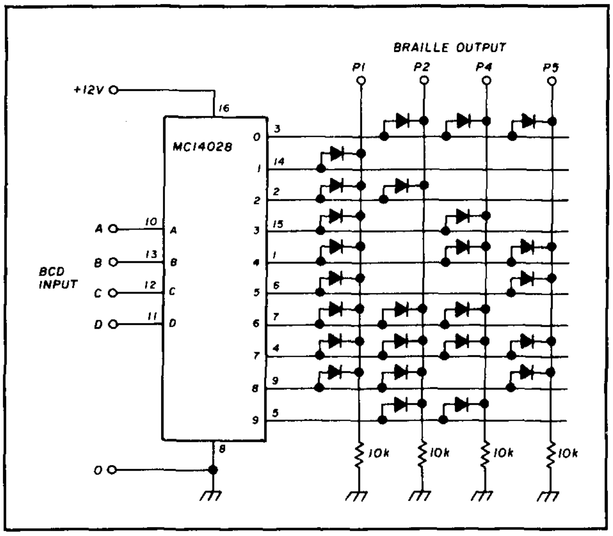
The transducer's driving circuit (**fig. 10**) is controlled by the DVM's output through the BCD-to-Braille converter of **fig. 7**. The differentiating drivers (DR/DP), related to the decimal point (DP) P3 pins, are controlled by the range selector located in the DVM's front-end unit. The polarity information is obtained from a separate logic (**fig. 12**) made of a dual four-input NAND (IC1) and a dual four-input NOR (IC2) gate. IC1 decodes the 1100 sequence which, corresponding to the M1 multiplexing pulse, indicates that the polarity of Vx at DVM's input was reversed. IC2 detects the 0000 sequence that occurs when Vx = 0. The following are possible situations:

Vx = 0 figure transducers indicate 000 (in Braille 0111 0111 0111)
polarity transducer: no dot
0 < Vx < 0.999V figure transducers indicate Vx three-digit value
polarity transducer: +
−0.099V < Vx < 0 figure transducers indicate Vx three-digit value polarity transducers: −
Vx > 0.999V figure transducers: no dot
polarity transducer: +
Vx < −0.099V figure transducer: no dot
polarity transducer: −

Note: The CA 3162E accepts a maximum positive input voltage of 0.999 volts and a maximum negative one of 0.099 volts.

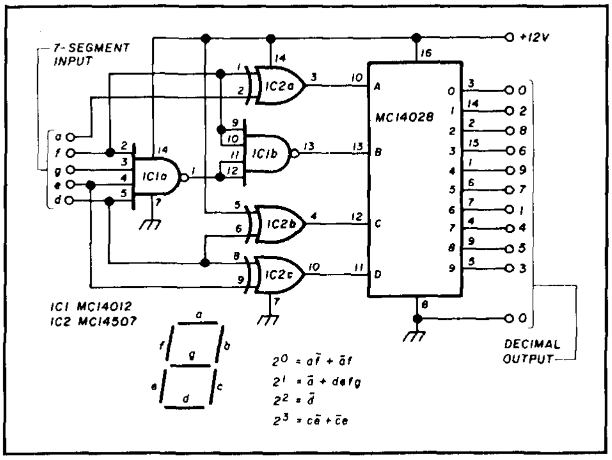
To turn the DVM into a true DMM (**photo C**), you need a front-end unit. **Figure 13** shows a circuit that you can use. It allows measurements of AC/DC voltages and currents, as well as resistances in the following ranges: 100 mV to 1 kV, 100 μA to 1 A, 100 ohm to 1 megohm.

FIGURE 7



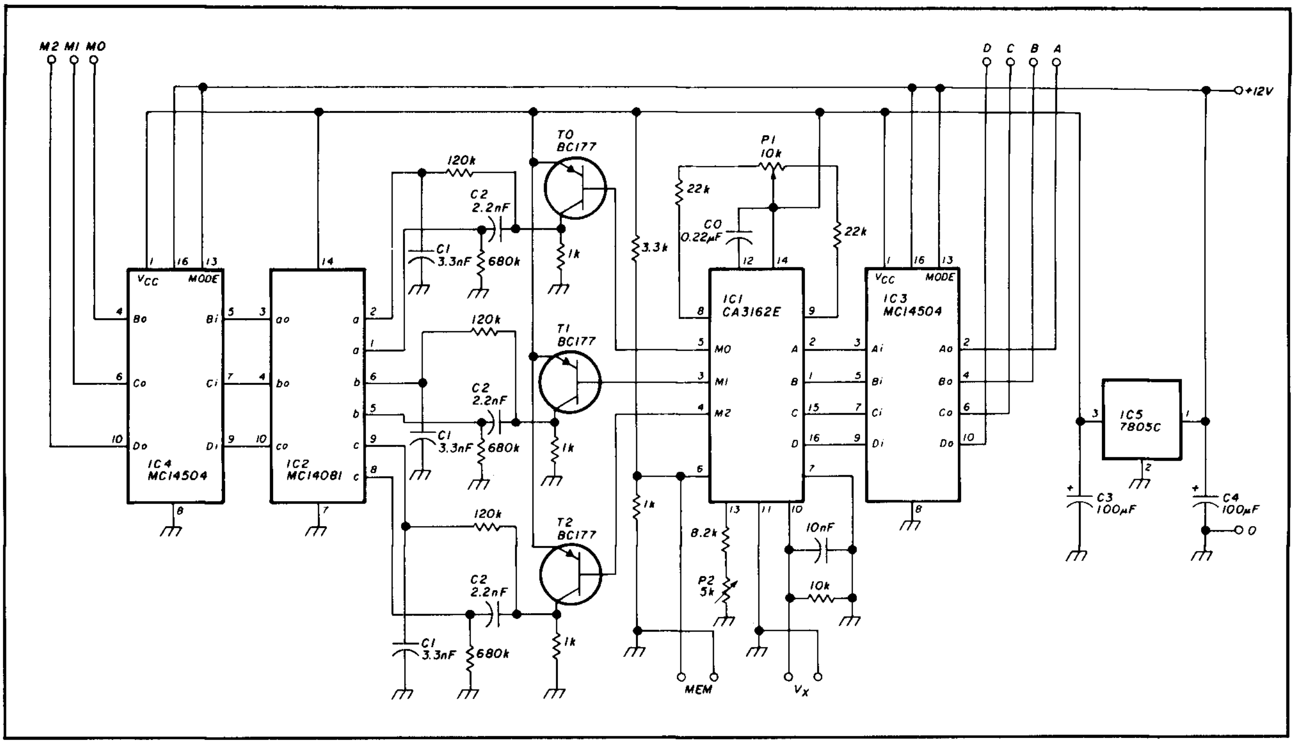
BCD-to-Braille data converter.

FIGURE 8



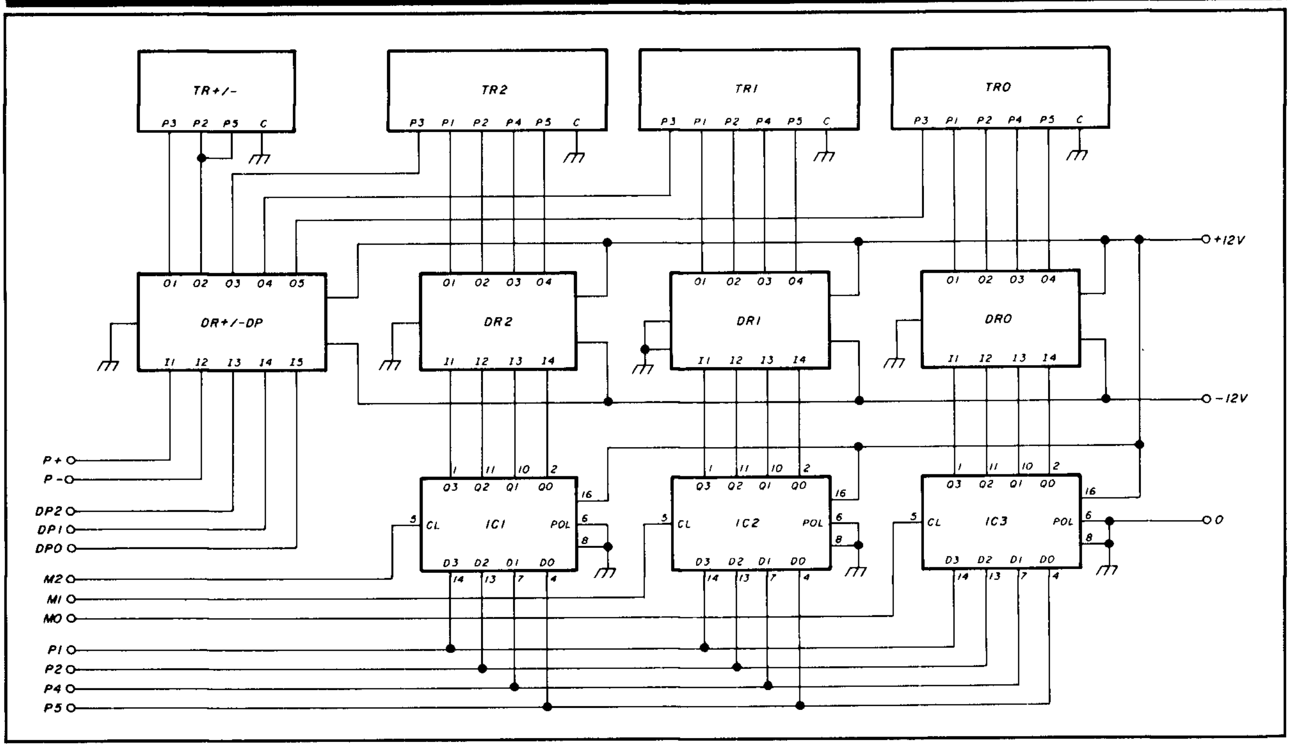
Seven-segment code-to-decimal converter.

FIGURE 9



Three-digit DVM suitable for driving a row of four bistable transducers.

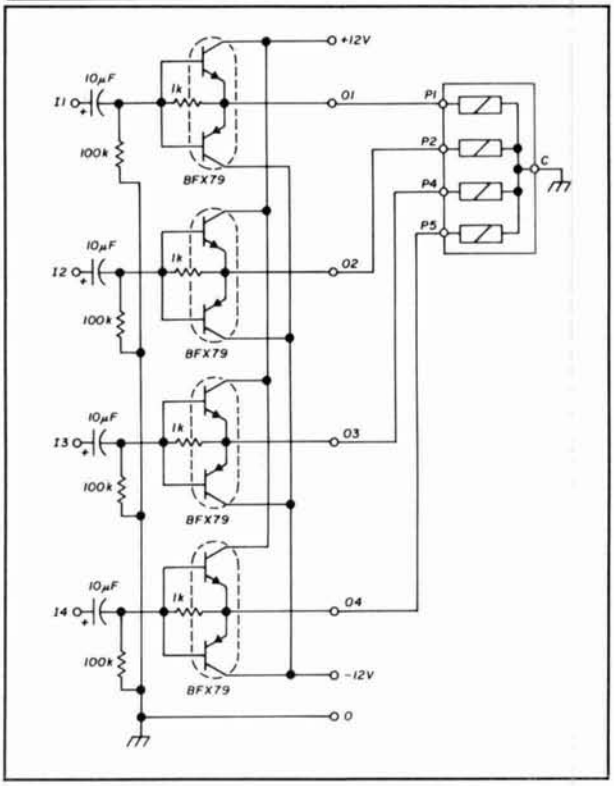
FIGURE 10



Control and drive circuit for the row of four bistable transducers.

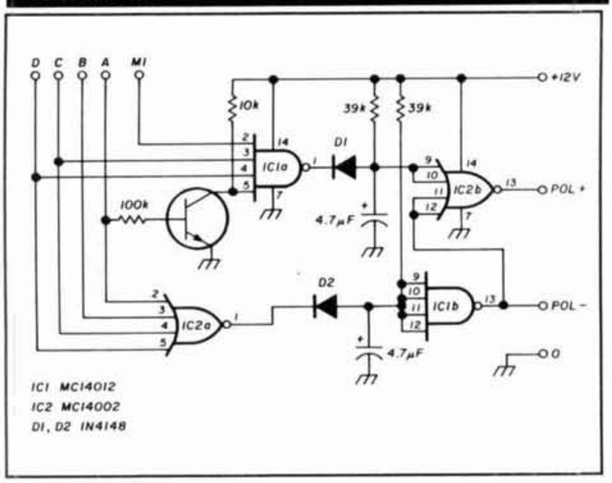
SW1 is the "mode;" SW2 is the "range" selector. SW3 provides polarity inversion, while closing SW4. The last measured data is saved into the reading row. The dual op amp (IC1) is a DC amplifier, the gain of which — in the lowest V/A range — is changed by T1 from 1 to 10. Dual op amp IC2 forms a precision AC-to-DC converter; dual op amp IC3 is the ohm-to-volt converter.

FIGURE 11



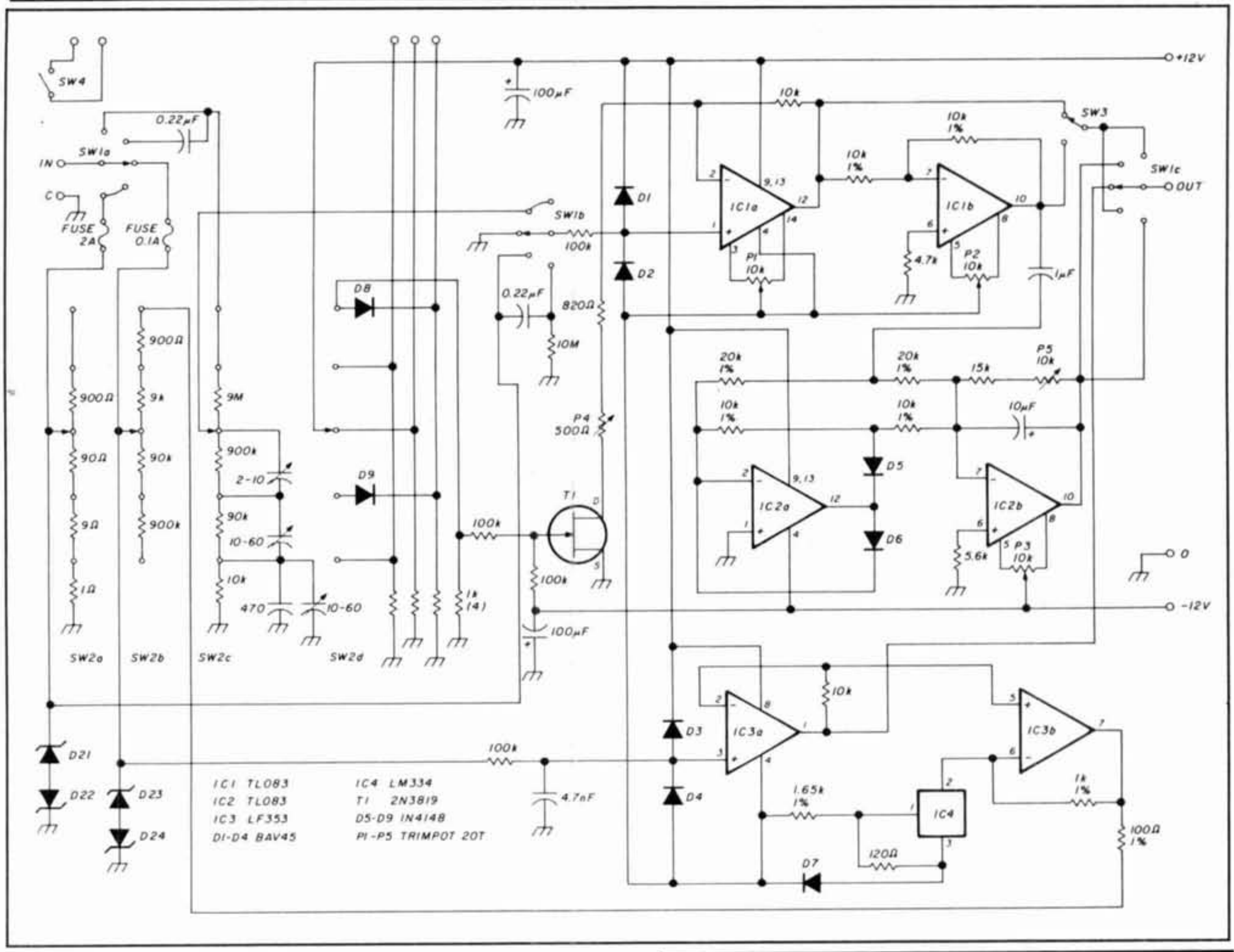
Quad differentiation driver (DR in *fig. 10*).

FIGURE 12



Schematic of the polarity information decoding circuit.

FIGURE 13



DVM front end suitable for driving the DVM of *fig. 9*.

FIGURE 13

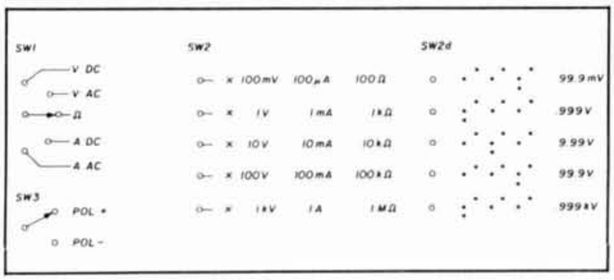
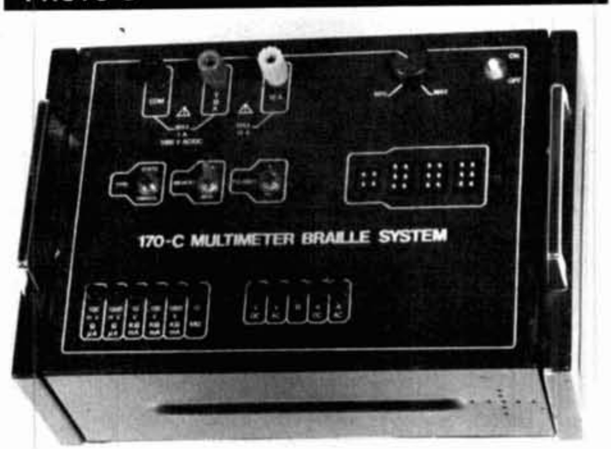


PHOTO C



Braille DMM equipped with a row of four monostable transducers. Ranges: 0.1 V to kV 0.1 mA to 10 A DC/AC; 100 ohm to 10 meg. Reading mode: static/vibrating. Power supply: 220 Vac.
Manufactured by P.A.M., Pertegada (Udine, Italy)

References

1. G.W. Horn, I4MK, "Reading Machines," *Elettronica Oggi*, November 1981, pages 135-155.
2. I.C. Bliss, "Sensory Aids for the Blind—A Challenging Problem with Lessons for the Future," proc. IEEE Vol. 58 no. 2, December 1970, pages 1778-1897.
3. G.W. Horn, I4MK, "Braille Tactile Transducer—New Freedom for the Sightless," *QST*, December 1981, pages 45-47.
4. W. Horn Jr., "An Electronic Notebook for the Sightless," Spirit of Enterprise, The 1981 Rolex Award, Harrap Editors, London.
5. W. Horn Jr., "La Conversione di Codice BCD-Braille Negli Strumenti Digitali di Misura per Non-Vedenti," Ham bit, 1986, CDR Editor, Firenze.
6. J. Southway, "IC-Trio Converts 7-segment Code to Decimal," *Electronics*, November 28, 1974, page 113.

Article I **HAM RADIO**

WIN A BILL ORR Handbook

Here's how.

Please fill out the Magazine evaluation card and mail it to us. We'll tabulate all the responses to see what you do and do not like.

There will be a drawing of evaluation cards. The person whose card is picked will win an Orr Handbook. Help us make the best Amateur magazine even better.

Also, each month the author of the most popular WEEKENDER will also be given a Bill Orr Handbook.

HAM RADIO

MAGAZINE EVALUATION & SWEEPS ENTRY CARD

Here's YOUR chance to comment on this issue of HR and enter our monthly radio drawing. Carefully read all the articles in this issue. Then, rate each article in this issue. Also let us know what *you think of our* changes to the magazine. Each article is marked with a letter on the last page.

Article	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
I LIKE IT																				
OK																				
SORRY, NO.																				

1. Are you employed in the electronics industry: ☐Yes ☐No
2. If so, what field: ☐RF ☐Digital ☐Analog ☐Computer
3. Do you affect purchasing decisions for your company: ☐Yes ☐No
4. Is Ham Radio: ☐too technical ☐just right ☐not technical enough

NAME ______________ Class License ________ Age ______

ADDRESS ______________________________

CITY ______________ STATE ________ ZIP ________

MAR. 89

☐ *One year* *12 issues* *$22.95*
☐ *Two years* *24 issues* *$38.95*
☐ *Three years* *36 issues* *$49.95*

Subscribe to HAM RADIO today. Tap into Amateur Radio's #1 technical and building journal. You'll also save $7.05 off the newsstand price ($30 per year)! Fill out this card and mail it in.

For even more prompt service, call TOLL FREE (800) 341-1522, MasterCard, VISA and Bill Me orders accepted. Phone lines open Monday thru Friday 8 a.m. to 9 p.m. Please, *orders only.*

☐ Bill me ☐ Payment enclosed

Name ______________________

Address ______________________

City ______________ State ________

☐ Check if this is a renewal MAR. 89

Please allow 4-6 weeks for delivery of first issue.

FOREIGN RATES: Europe via Air Forwarding Service $40 per year. All other countries $31.00 per year.

HAM RADIO Reader Service

For FREE literature or more information, first locate the company number at the bottom of the ad. Circle the appropriate number on this *card, affix postage and drop into the mail.* We'll hustle your request off to the companies you are interested in!

101	113	125	137	149	161	173	185	197	209	221	233	245	257	269	281	293	305	317	329	341
102	114	126	138	150	162	174	186	198	210	222	234	246	258	270	282	294	306	318	330	342
103	115	127	139	151	163	175	187	199	211	223	235	247	259	271	283	295	307	319	331	343
104	116	128	140	152	164	176	188	200	212	224	236	248	260	272	284	296	308	320	332	344
105	117	129	141	153	165	177	189	201	213	225	237	249	261	273	285	297	309	321	333	345
106	118	130	142	154	166	178	190	202	214	226	238	250	262	274	286	298	310	322	334	346
107	119	131	143	155	167	179	191	203	215	227	239	251	263	275	287	299	311	323	335	347
108	120	132	144	156	168	180	192	204	216	228	240	252	264	276	288	300	312	324	336	348
109	121	133	145	157	169	181	193	205	217	229	241	253	265	277	289	301	313	325	337	349
110	122	134	146	158	170	182	194	206	218	230	242	254	266	278	290	302	314	326	338	350
111	123	135	147	159	171	183	195	207	219	231	243	255	267	279	291	303	315	327	339	
112	124	136	148	160	172	184	196	208	220	232	244	256	268	280	292	304	316	328	340	

NAME ______________________ CALL ________

ADDRESS ______________________________

CITY ______________ STATE ________ ZIP ________

PLEASE USE BEFORE MAY 31, 1989 MARCH 1989

AFFIX POSTAGE
OR
POST OFFICE
WILL NOT
DELIVER

HAM RADIO

MAIN STREET
GREENVILLE, N.H. 03048

Please enter my subscription

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD

First Class Permit No. 1 Greenville, NH

Postage Will Be Paid By Addressee

HAM RADIO

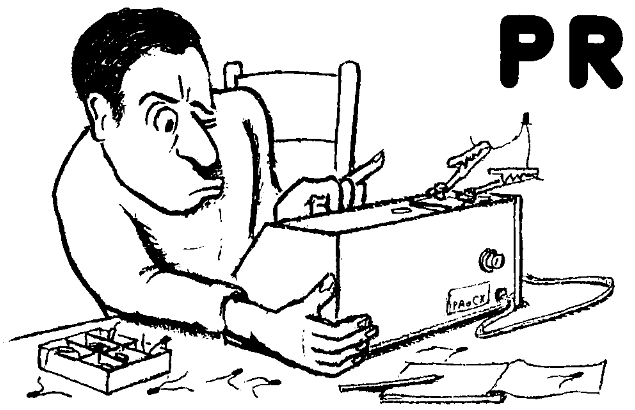
Greenville, NH 03048

AFFIX POSTAGE
OR
POST OFFICE
WILL NOT
DELIVER

HAM RADIO

READER SERVICE CENTER
P.O. BOX 2558
WOBURN, MASS. 01888

ATTN: Reader Service Dept.



PRACTICALLY SPEAKING

Joe Carr, K4IPV

RF wattmeters and antenna VSWR meters

The RF power meter (or wattmeter) is a "must" for Amateurs. This instrument measures the output power of the transmitter, and displays the result in watts or some related unit. Antenna VSWR (voltage standing wave ratio) meters are closely related to the RF wattmeter. These instruments also examine the output of the transmitter, and give a relative indication of output power. They can be calibrated to display the dimensionless units of VSWR. Many modern instruments, which I'll discuss this month, combine both RF power and VSWR measurement capabilities.

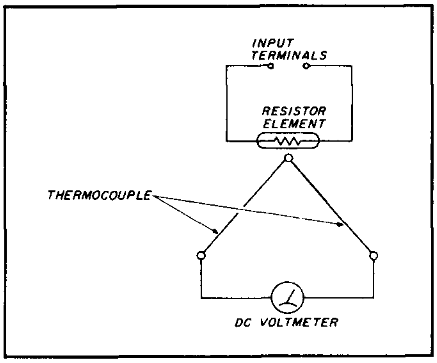
Measuring RF power

Measuring RF power has been notoriously difficult — except, perhaps, in the case of continous wave (CW) sources that produce well-behaved sine waves. Even in that limited case, however, some measurement methods are distinctly better than others.

One of the earliest forms of practical RF power measurement was the thermocouple RF ammeter (see **fig. 1**). This instrument works by dissipating a small amount of power in a small resistance inside the meter, and then measuring the heat generated with a thermocouple. A DC current meter monitors the output of the thermocouple device, and indicates the level of current flowing in the heating element. Because it works on the basis of power dissipated heating a resistance, a thermocouple RF ammeter is inherently an RMS reading device. This feature makes it very useful for taking average power measurements. If you know the RMS current and the resistive component of the load impedance, and if the reactive component is zero or very low, then you can determine RF power from the expression:

$$P = I2 \times R_i \quad (1)$$

FIGURE 1

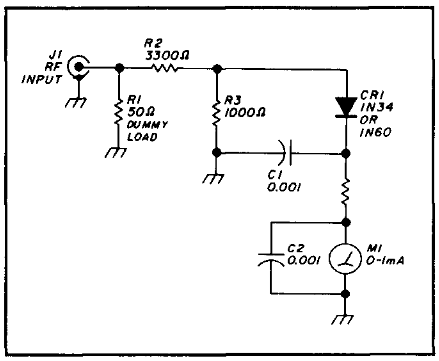


Schematic representation of a thermocouple RF ammeter.

There is a significant problem that keeps thermocouple RF ammeters from being universally used in RF power measurement — they are highly frequency dependent. Even at low frequencies it's recommended that the meters be mounted on insulating material with at least 3/8-inch spacing between the meter and its metal cabinet. Despite that precaution, there's a strong frequency dependence that renders the meter less useful at higher frequencies. Some meters are advertised to operate into the low VHF region, but a note of caution is necessary. The recommendation requires a copy of the calibrated frequency response curve for that particular meter so that a correction factor can be added or subtracted from the reading. At 10 MHz and higher, the readings of the thermocouple RF ammeter must be taken with a certain amount of skepticism, unless the original calibration chart is available.

You can also check RF power by measuring the voltage across the load resistance (see **fig. 2**). In the circuit of **fig. 2**, the RF voltage appearing across the load is scaled downward to a level compatible with the voltmeter by resistor voltage divider R2/R3. The output

FIGURE 2



Schematic of a simple diode voltmeter used for measuring RF power of an unmodulated sinusoidal waveform.

of this divider is rectified by CR1, and filtered to DC by the action of capacitor C2.

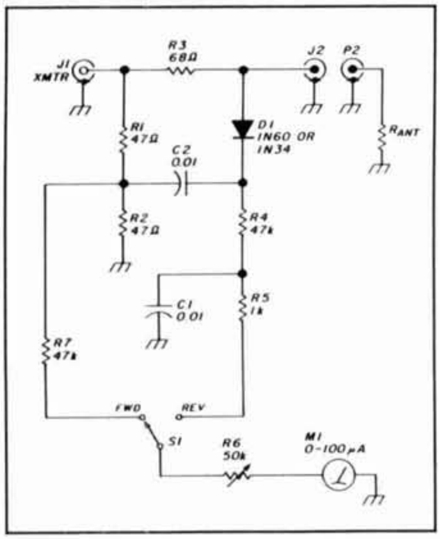
The method of measuring the voltage in a simple diode voltmeter is valid only if the RF signal is unmodulated and has a sinusoidal waveshape. While these criteria are met in many transmitters, they aren't universal. If the voltmeter circuit is peak reading, as in **fig. 2**, then the peak power is:

$$P = (V_o^2)/R1 \qquad (2)$$

The average power is then found by multiplying the peak power by 0.707. Some meter circuits include voltage dividers that precede the meter and thereby convert the reading to RMS, thus also converting the power to average power. Again, it must be stressed that terms like "RMS," "average," and "peak" have meaning only when the input RF signal is both unmodulated and sinusoidal. Otherwise, the readings are meaningless unless calibrated against some other source.

It's also possible to use various bridge methods to measure RF power. **Figure 3** shows a bridge set up to measure both forward and reverse power. (**Photo A** is a commercial version used for CB servicing.) This circuit was once popular for VSWR meters. There are four elements in this quasi-Wheatstone bridge circuit: R1,

FIGURE 3



VSWR bridge circuit for measuring both forward and reverse power.

PHOTO A

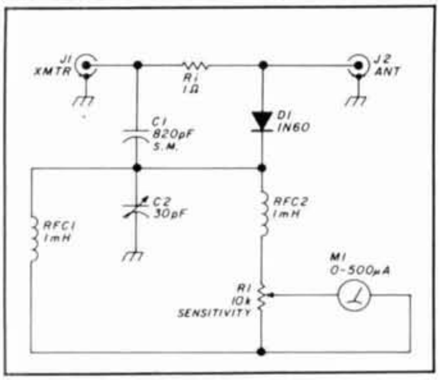
Commercial forward/reflected reading power meter.

R2, R3, and the antenna impedance (connected to the bridge at J2). If R_{ant} is the antenna resistance, we know that the bridge is in balance (the null condition) when the ratios R1/R2 and R3/R_{ant} are equal. In an ideal situation, resistor R3 will have a resistance equal to R_{ant}, but that may severely limit the usefulness of the bridge. In some cases, the bridge will use a compromise value like 68 ohms for R3. A resistor of this type will be usable on both 50 and 75-ohm antenna systems with little error. Typically, these meters are designed to read the relative power level rather than the actual power.

This type of meter allows you to make an accurate measurement of VSWR by proper calibration. With the switch in the FORWARD position, and RF power applied to J1 ("XMTR"), potentiometer R6 is adjusted to produce a full-scale deflection on meter M1. When the switch is then set to the REVERSE position, the meter will read reverse power relative to the VSWR. An appropriate VSWR scale is provided.

There is a significant problem with the bridge in **fig. 3**. It can't be left in the circuit during transmission because it dissipates a considerable amount of RF power in the internal resistances. These meters, during the time when they were popular, had switches that bypassed the bridge when transmitting. The bridge was only in the circuit when making a measurement.

FIGURE 4



An improved Micromatch circuit using a capacitor/resistor bridge circuit for power measurements.

PHOTO B

Micromatch forward/reflected reading power meter with three power scales.

An improved bridge circuit, the capacitor/resistor bridge, is shown in **fig. 4**. This circuit is called the "Micromatch" bridge. You can see immediately that the Micromatch is an improvement over the conventional bridge because it uses only 1 ohm in series with the line (R_i). This resistor dissipates considerably less power than the resistance used in the previous example. Because of this low value resistance, you can leave the Micromatch in the line while transmitting. Recall that the ratios of the bridge arms must be equal for the null condition to occur. In this case, the capacitive reactance ratio of C1/C2 must match the resistance ratio $R1/R_{ant}$. For a 50-ohm antenna, the ratio is 1:50; for 75-ohm antennas it's 1:75 (or, for the compromise situation, 1:68). The small-value trimmer capacitor (C2) must be adjusted for a reactance ratio with C1 of 1:50, 1:75, or 1:68, depending upon how the bridge is set up.

The sensitivity control can be used to calibrate the meter. In one version of the Micromatch (shown in **photo B**) there are three power ranges — 10, 100, and 1000 watts. Each range has its own sensitivity control, and these are switched in and out of the circuit as needed.

The Monomatch bridge circuit in **fig. 5** is the instrument of choice for most HF and low VHF applications. In the Monomatch design, the transmission line is segment B; RF sampling elements are formed by segments A and C. Although the original designs were based on a coaxial cable sensor, later versions used either printed circuit foil transmission line segments or parallel brass rods for A, B, and C.

The sensor unit is basically a directional coupler with a detector element for both forward and reverse directions. For best accuracy diodes CR1 and CR2 should be matched, as should R1 and R2. The resistance of R1 and R2 should match the transmission line surge impedance, although in many instruments a 68-ohm compromise resistance is used.

PHOTO C

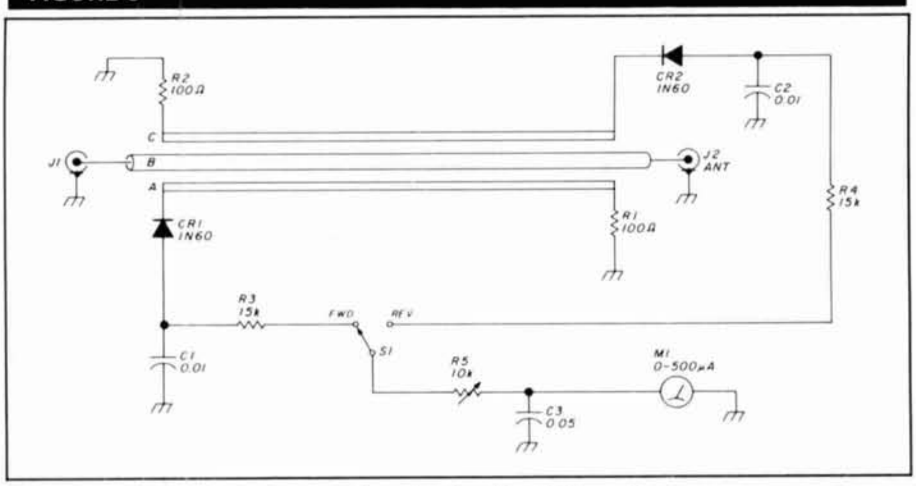
Midland forward/reflected reading power meter and VSWR meter combined in one housing.

The circuit shown in **fig. 5** uses a single DC meter movement to monitor the output power. Many modern designs use two meters (one each for forward and reverse power), as in **photo C**.

One of the latest designs in VSWR meter sensors is the current transformer assembly shown in **fig. 6**. In this instrument a single-turn ferrite-toroid transformer is used as the directional sensor. The transmission line passing through the hole in the toroid "doughnut" forms the primary winding of a broadband RF transformer. The secondary, which consists of 10 to 40 turns of small enamel wire, is connected to a measurement bridge circuit (C1 + C2 + load) with a rectified DC output.

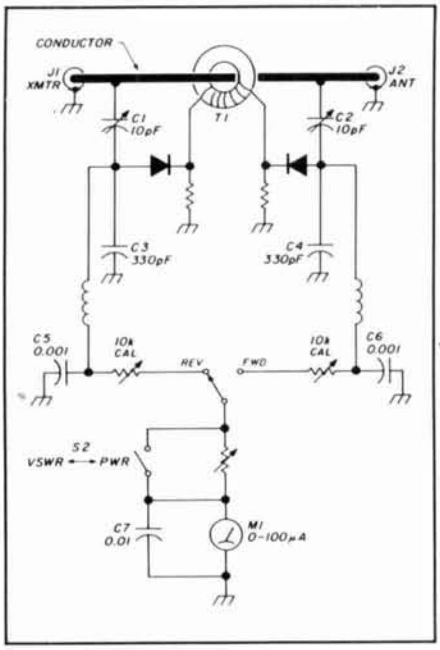
Photo D shows the Heath Model HM-102 high-frequency VSWR/Power meter. The sensor in the HM-102 is a variant of the current transformer

FIGURE 5



Schematic of the Monomatch bridge circuit using RF sampling.

FIGURE 6

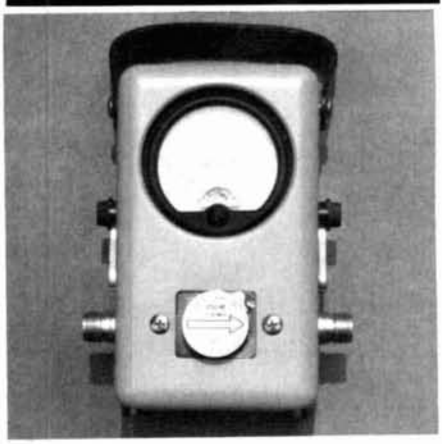


Schematic of the latest design for VSWR bridges using a current transformer made from a single-turn ferrite toroid acting as a directional sensor.

PHOTO D

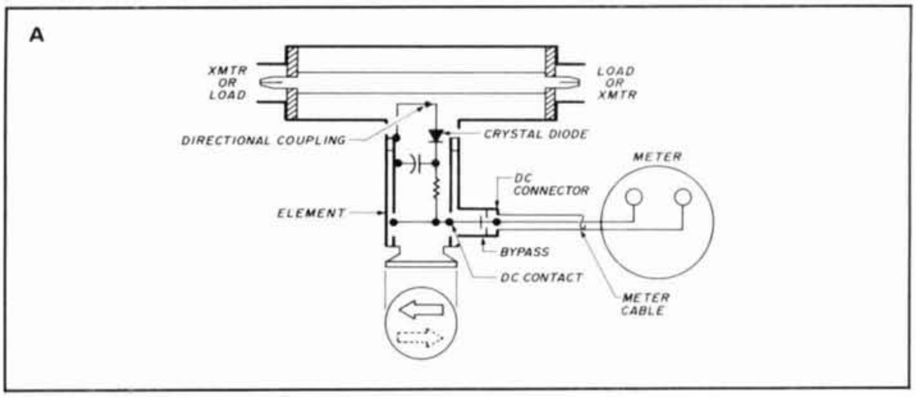
Heath combined power/VSWR meter with wired remote sensor.

PHOTO E



Bird Thruline forward/reflected reading power meter.

FIGURE 7



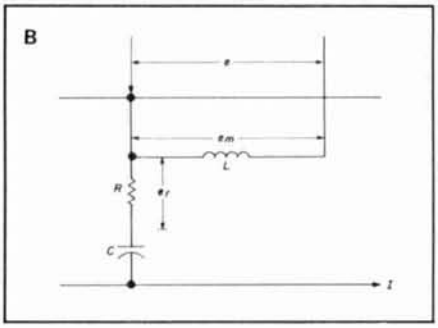
Detail of the directional coupler transmission line assembly used for Thruline measurements.

method and L1 is the toroid transformer. This instrument measures both forward and reflected power, and can be calibrated to measure VSWR.

The Bird Model 43 Thruline® RF wattmeter shown in **photo E** has been one of the industry standards in communications service work for years. Although it's slightly more expensive than lesser instruments, it's also versatile, accurate, and rugged. The Thruline meter can be inserted into the transmission line of an antenna system with so little loss that it can be left permanently in the line during normal operations. The Model 43 Thruline is popular with land-based mobile and marine radio technicians.

The heart of the Thruline meter is the directional coupler transmission line assembly shown in **fig. 7A**. It is connected in series with the antenna or dummy load transmission line. The plug-in directional element can be rotated 180 degrees to measure both forward and reverse power levels. A sampling loop and diode detector are contained within each plug-in element. The main RF barrel is actually a special coaxial line segment with a 50-ohm characteristic impedance. The Thruline sensor works because of mutual inductance between the sample loop and center conductor of the coaxial element. **Figure 7B** shows an equivalent circuit. The output voltage from the sampler (e) is the sum of two voltages, e_r and e_m. Voltage e_r is created by the voltage divider action of R and

FIGURE 7



Equivalent circuit demonstrating the theory of operation for the Thruline sensor.

C on transmission line voltage E. If R is much less than X_c, then the expression for e_r may be written

$$e_r = RE/X_c = RE(jwC) \tag{3}$$

Voltage e_m, on the other hand, is due to mutual inductance and is expressed by

$$e_m = I(jw) \pm M \tag{4}$$

You now have the expression for both factors that contribute to the total voltage e. You know that

$$e = e_r + e_m \tag{5}$$

so, by substitution,

$$e = jwM((E/Z_o) \pm I) \tag{6}$$

By recognizing that, at any given point in a transmission line, E is the sum of the forward (E_f) and reflected (E_r) voltages, and that the line current is equal to

$$I = \frac{E_f}{Z_o} - \frac{E_r}{Z_o} \tag{7}$$

where Z_o is the transmission line

impedance, you may specify e in the forms

$$e = \frac{jwM(2Ef)}{Z_o} \quad \textbf{(8)}$$

and

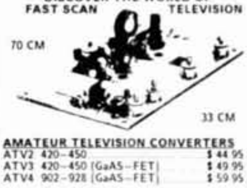
$$e = \frac{j\ w\ M(2Er)}{Z_o} \quad \textbf{(9)}$$

The output voltage e of the coupler, then, is proportional to the mutual inductance and frequency (by virtue of jwM). But the manufacturer terminates R in a capacitive reactance, so the frequency dependence is lessened. Therefore, each element is custom calibrated for a specific frequency and power range. Beyond the specified range for any given element, however, performance isn't guaranteed. There are a large number of elements available that cover most Amateur Radio applications.

Conclusion

The RF wattmeter, and/or its cousin the VSWR meter, are essential items in the Amateur Radio operator's bag of tricks. Both these instruments are used for adjusting antennas and testing the output of radio transmitters.

Article J **HAM RADIO**



ATTENTION: WOMEN WHO SOUGHT EMPLOYMENT WITH THE VOICE OF AMERICA (VOA), THE UNITED STATES INFORMATION AGENCY (USIA), OR THE UNITED STATES INTERNATIONAL COMMUNICATION AGENCY (USICA) BETWEEN OCTOBER 8, 1974 AND NOVEMBER 16, 1984.

YOU MAY BE A VICTIM OF SEX DISCRIMINATION ENTITLED TO A MONETARY AWARD AND A POSITION WITH THE AGENCY.

UNITED STATES DISTRICT COURT FOR THE DISTRICT OF COLUMBIA

CAROLEE BRADY HARTMAN, et al., Plaintiffs, v. CHARLES Z. WICK, Defendant	Civil Action No. 77-2019 Judge Charles R. Richey

PUBLIC NOTICE

On November 16, 1984, the United States District Court for the District of Columbia found in this class action lawsuit that the United States Information Agency (USIA or the Agency), including the Voice of America (VOA), is liable for sex discrimination against female applicants for the following positions at the Agency. The USIA was also formerly known as the United States International Communication Agency (USICA). On January 19, 1988, the Court issued its opinion ordering relief in avariety of forms to potential class members. Accordingly, this case is now in the remedial phase.

JOBS COVERED

Specifically, the Court has found that the Agency has discriminated against women in hiring in the following jobs:

- Electronic Technician (Occupational Series 856)
- Foreign Language Broadcaster (Occupational Series 1048)
- International Radio Broadcaster (Other) (Occupational Series 1001)
- International Radio Broadcaster (English) (Occupational Series 1001)
- Production Specialist (Occupational Series 1071)
- Writer/Editor (Occupational Series 1082)
- Foreign Information Specialist/Foreign Affairs Specialist/Foreign Service Information Officer/Foreign Service Officer (Occupational Series 1085 and 130)
- Radio Broadcast Technician (Occupational Series 3940)

WHO IS INCLUDED

All women who sought employment with the Agency in any of the jobs listed above between October 8, 1974 and November 16, 1984 and were not hired may be eligible for relief. Also included are those women who were discouraged from applying for these positions during that time period. Even those women subsequently hired by the Agency in some capacity may be entitled to participate in the remedial phase of this case.

Women who sought employment with the Agency as Foreign Service Officers or Foreign Service Information Officers may be eligible for different kinds of relief depending upon the date of application and whether they sought employment at the entry level or mid-level. Women who sought employment with the Agency as entry level Foreign Service Officers or Foreign Service Information Officers in the years 1974-1977 must use the procedure outlined below. Women who sought employment with the Agency as mid-level Foreign Service Officers or Foreign Service Information Officers in the years 1974-1984 must also use the procedure outlined below. However, women who sought employment with the Agency as entry level Foreign Service Officers or Foreign Service Information Officers in the years 1978-1984 cannot use the procedure outlined below, since the Court has ordered an alternative form of relief for them and selected women in this group will be notified individually as to their rights.

RELIEF AVAILABLE AND HOW TO OBTAIN IT

Relief available to class members may include a monetary award and/or priority consideration for a current position with the Agency. If you think you may be entitled to relief, you must obtain a claim form, complete it fully, and return it to counsel for the plaintiff class, Bruce A. Fredrickson, Esq., Webster & Fredrickson, 1819 H Street, N.W., Suite 300, Washington, D.C. 20006 (202/659-8515), postmarked no later than July 15, 1989.

You may obtain a claim form in person and/or in writing from several sources: counsel for the plaintiff class, whose address is listed above; in person from USIA, Front Lobby, 301-4th Street, S.W., Washington, D.C. (8:15am-5:00pm), Office of Personnel Management (OPM), Federal Job Information Center (First Floor, Room 1425), 1900 E Street, N.W., Washington, D.C. (8:30am-2:30pm), or from area OPM offices throughout the country; in writing, VOA-Hartman, P.O. Box 400, Washington, D.C. 20044. You should carefully consider all questions on the claim form, sign it, and return it to counsel for the plaintiffs. Do not, under any circumstances, return the claim form to the Judge, the Court or the Clerk of the Court. The Judge, the Court and the Clerk of the Court will not accept the claim forms and will not forward claim forms to plaintiffs' counsel.

PROCESSING OF CLAIMS

The process for handling claims has not been finally decided. Thus far, the Court has ordered that responding class members demonstrate their potential entitlement to relief at an individual hearing to be scheduled at a later date. However, the Court has reserved the right to reconsider this procedure in the event the number of claims filed makes this approach unmanageable.

Should individual hearings be used, you will be fully informed as to the date and time of your hearing. Moreover, you will be entitled to legal representation by counsel for the plaintiff class or his designee at no cost to you. Legal counsel will discuss your claim with you prior to your hearing, help you prepare your case and represent you at your hearing. You may, of course, retain your own attorney to represent you, if you so desire.

At the individual hearing, you will be asked to demonstrate your potential entitlement to relief by showing that you applied for one or more of the covered positions during the period October 8, 1974 and November 16, 1984 and that you were rejected, or that you were discouraged from applying. Evidence may be required in the form of testimony, documents, or both. Once you have demonstrated these facts, USIA is required to prove, by clear and convincing evidence, that you were not hired (for each position for which you applied) for a legitimate, non-discriminatory reason, such as failure to possess requisite qualifications. Should USIA make such a showing, you would then be entitled to demonstrate that the Agency's reason is merely a cover for sex discrimination or unworthy of belief.

Following the hearing, the Presiding Official will decide whether you are entitled to relief and, if so, what relief is appropriate. You may be entitled to wages and benefits you would have earned if you had been hired (back pay) from the date of your rejection until the date relief is approved. Under the law, back pay is offset by earnings you may have had during the period. In addition, you may be found to be entitled to front pay (that is, compensation into the future until an appropriate position is afforded you). Similarly, you may be found to be entitled to priority consideration for employment with the Agency. If hired, you may further be entitled to retroactive seniority with the associated benefits and the value of any promotions you would likely have had if you had not suffered discrimination.

REQUIRED STEPS TO FILE YOUR CLAIM

To participate in the remedial phase, you must fully complete the claim form and return it, POSTMARKED NO LATER THAN July 15, 1989, to counsel for the plaintiff class. Your failure to do so will result in your losing all rights you may have in this lawsuit. If you have questions about your rights or procedures available to you, you may contact counsel for the plaintiff class:

Bruce A. Fredrickson
Webster & Fredrickson
1819 H Street, N.W., Suite 300
Washington, D.C. 20006
(202/659-8515)

October 4, 1988
Date

/s/ Judge Charles R. Richey
United States District Court
Judge Charles R. Richey

A SIMPLE PROM PROGRAMMER

An easy alternative for entering short programs

By Michael Moore, WV6A, 2221 West Manly Avenue, Santa Ana, California 92704

Programmable Read Only Memories (PROMs) are devices used in circuits requiring a pattern of "ones and zeros" in a specific sequence. One use is to store computer programs; another is to store a sequence of digital numbers accessible by a counter attached to the memory address lines. In this way, you can make a counter circuit that generates a sequence like 1, 2, 3, 4, etc. output the sequence 5, 9, 4, etc. This is useful for doing operations like code conversion. (I have seen an example of International Morse Code being converted to upper case ASCII.)

In the September 1988 issue of *Ham Radio*[1], I demonstrated how to use a PROM in a DTMF signaling circuit. I built the circuit to monitor the output of a 2-meter handie-talkie radio for DTMF tones so that I could receive signals from other operators without having to stay glued to the radio. The circuit converts the tones it hears into a digital code and compares this code with one I've stored in a PROM. After the circuit finds a match, it increments a counter that addresses the PROM, readying it for the next DTMF tone comparison. When there are four valid compares, an alarm lets me know that somebody who has my four-digit code is trying to reach me.

About the PROM

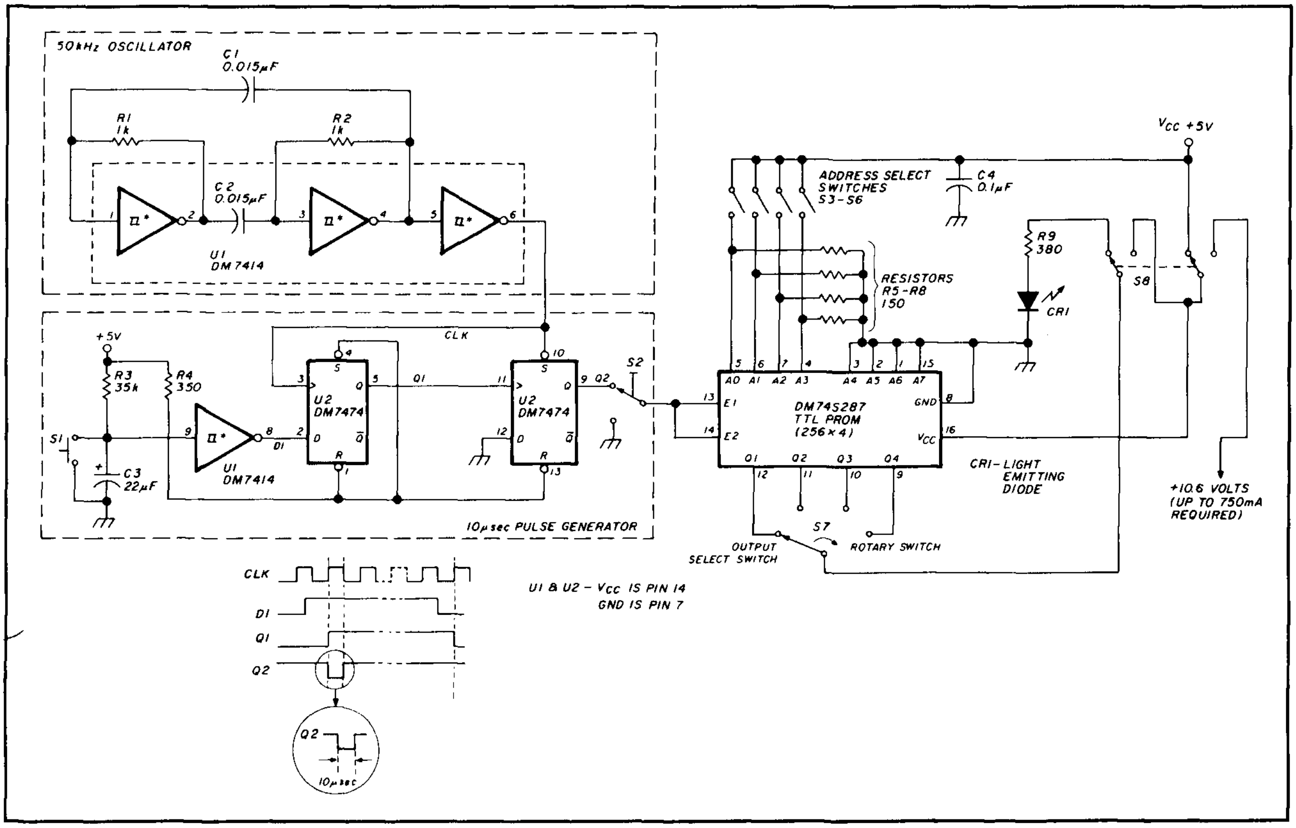
The circuit used a DM74S287 manufactured by National Semiconductor Corporation. It's one of a family of devices featuring titanium-tungsten (Ti:W) fuse links designed to "blow" when 10.5 volts is applied across them. The PROMs are shipped from the factory with all fuses intact; this produces lows (zeros) in all locations. You can program a high level into any location by following the programming instructions to blow that fuse. This is an irreversible procedure — once a fuse is blown it will always produce a high at that location. (A fuse left intact can always be blown later.)

The DM74S287 memory is organized as 256 words, each 4 bits long. Two enable lines control the device's output. When the PROM is enabled, the outputs represent the contents of the word selected by its address line states. There are eight address lines allowing for 256 combinations, or one combination for each 4-bit word. When the enable lines are high (disabled) the outputs revert to "off," or high-impedance state.

Don't confuse these PROMS with erasable programmable read only memories (EPROMs) or electrically erasable PROMs (EEPROMs). EPROMs have special circuits allowing the memory contents, once programmed, to be erased when ultraviolet light is applied through a quartz window in the top of the package. Once erased, it can be reprogrammed. The EEPROM is erased when certain high voltage levels are applied to specific pins.

There are several manufacturers of fusible-link PROMs; Texas Instruments and Advanced Micro Devices are two. These manufacturers use different

FIGURE 1



The schematic for the PROM programmer.

materials for their fuses, making the requirements to burn out the fuses different. To circumvent this problem, commercial PROM programming machines use "personality modules." They reconfigure the programmer so that the programming is done using the original PROM manufacturer's instructions. Failure to specify the manufacturer to these PROM programming machines can result in a failed programming operation or a failed PROM.

The PROM programmer is simple to construct and can manually blow the few locations required for National Semiconductor Corporation's DM74S287 PROM. I built the whole thing on a breadboard and tore it down later to do another project. I've since built several other signaling devices and had to rebuild the programmer. It's now housed in a small plastic box complete with a light-emitting diode (LED), address selection switches, mode switch, programming switches, and a socket for the PROM. External leads supply the voltages required.

Programming the PROM

The manufacturer's instructions indicate that programming should be done between 15 and 30 degrees Celsius. Address and enable inputs can only be driven with TTL logic levels during programming and verification. To program the device, select the word to be programmed using the address select switches. These switches, depending on their setting, put either a high or a low on the four least significant address bits. (I only had to program six locations for the DTMF decoder, so it was possible to hard wire the four most significant address lines to zero). Next, disable the programmer by applying a high level to one or both of the "active low" chip enable inputs.

Now apply 10.5 volts to both Vcc and the output to be programmed. Do this simultaneously, or to Vcc first and then the output. (You'll incur damage if the output sees the 10.5 volts before Vcc). It's *critical* that only one output at a time is programmed, because the internal circuits can supply programming current up to only 750 mA at a time. You must leave outputs not being programmed open or connected to a high impedance source of 20 k minimum. To continue, enable the device briefly with a low level pulse of 10 (minimum 9 and maximum of 11) μS; this should blow the selected fuse. Now verify the programming by returning Vcc to 5 volts, connecting the output to a LED, and re-enabling the device. If the bit was not programmed, repeat the operation — up to 10 times, according to the manufacturer. (I've yet to do this more than four times.) The manufacturer recommends that, once you've done your verification, five additional programming pulses should be applied to the bit being programmed. This completes the programming for that bit. Move on to the next one and repeat the process until programming is completed.

The circuit shown in **fig. 1** uses two Schmitt trigger inverters of a single DM7414 (this package contains six inverters) with feedback to produce a simple 50-kHz oscillator. A third inverter squares up the resulting output. Simple inverters like those in the DM7404 will also work. But the frequency of oscillation is less dependent on the supply voltage when you use the DM7414 because of the built-in hysteresis. If you have access to an oscilloscope or frequency counter you can adjust the values of C1, C2, R1, and R2 to obtain a good square wave with a 20-μS period measured on pin 6 of U1. I've experimented with several DM7414 and DM5414 (the military versions of the DM7414s), as well as several examples of resistors at 1 k and several 0.015-μF capacitors, and the frequency I observed was pretty close to the 50 kHz. The time during which the output is at a high level (10 μS) is the length of the programming pulse generated by U2.

If you can't get hold of an oscilloscope or other timing device, a good alternative would be a substitute oscillator using a 100-kHz crystal. Divide it by 2 to produce a clock of 50 kHz with a 50-percent duty cycle, so that the low-level excursion is 10 μS. You can do this with a DM7474 D-type flip-flop with the inverting output wired back to the D input and the oscillator output applied to the D flip-flop's clock input.

The pulse generator uses another of the Schmitt trigger inverters with C3 and R3 to debounce the pulse from the momentary push button switch S1. This activates the two D-type flip-flops of U2, which is clocked from the oscillator to produce the 10-μS PROM enabling pulse. Switch S2 is a momentary push button switch, used to select between the 10-μS pulse for programming or continuous enabling during the verification phase. The released position of this switch should select the pulse generator output, with continuous PROM enabling only when the switch is held down. In the held-down position it enables the PROM so that the outputs can be displayed on the LED.

Switches S3 through S6 are the address selection switches. You can add more if necessary to program more words of the PROM. S7 is a rotary-type switch that selects the output bit to be programmed. Switch S8 is a double-pole switch — one pole selects the power supply voltage to the Vcc pin (16) of the PROM; the other either directs 10.5 volts to the output, or outputs the PROM itself to the LED.

The resistor at R4 pulls up the unused inputs of U2; R9 is a current-limiting resistor for the LED. Capacitor C4 is a Vcc decoupling capacitor and should be located as close to the oscillator U1 as possible.

Example of a programming operation

Suppose you want to insert the code 0100 (decimal 4) at memory location 5. Close the switches controlling address selection for the A3 and A0 inputs of the PROM (for a high level), and set A2 and A1 open. Next, set S8 to direct the PROM output to the LED and the Vcc to be at 5 volts. Call this the "verify" position. Depress switch S2 to enable the PROM (the "display" position). Rotating S7 through each of the four output positions should show that all outputs are low; that is, the LED will remain off. Now select output Q3 with S7, and S2 is released — ready for the PROM to be enabled from the pulse generator. Only after S2 has been released can you move S8 to the programming position, by selecting the 10.5 volts to the output pin and Vcc pin, respectively.

Depress and release the momentary pushbutton switch, S1; this enables the PROM for 10 μS. Then return switch S8 to the verify position and push S2 to display the output. If the bit was programmed correctly the LED will light. If it does, release S2 and then return S8 to the programming position — in that order. Depress push button switch S1 five more times in succession. If the bit fails to program on the first attempt, you can repeat the sequence of switch settings. Remember, however, to ensure that S2 is never in the display position (depressed when S8 is in the programming position).

To generate the power supplies I used four NiCd batteries in series. Together they produce about 4.8 volts for the nominal 5-volt supply and a variable power supply set to 10.5 volts for the programming supply. I used a multimeter to adjust this to within 0.5 volt. If a variable power supply is not available, connecting seven 1.5-volt alkaline cells in series will work. Remember that this supply should be capable of delivering **750 mA** during the 10-μS programming pulse.

For fused PROMs made by other manufacturers the same principles hold; however, each specifies differing voltage levels during longer or shorter programming pulses. Changing the values of C1, C2, R1, and R2 will vary the oscillator frequency up to about 10 MHz. This gives you some idea as to the range of pulses that can be produced. When blowing a PROM it's best to make a careful list of each bit that you need to change to a high level and methodically work your way through them. I don't recommend trying to blow a PROM for a large computer program in this fashion — but for simple uses like code converters, or for the DTMF tone signaling circuit, it works very well and doesn't take long to put together.

References

1. Michael S.R. Moore, WV6A, "A DTMF Tone Signaling Circuit," *Ham Radio*, September 1988, page 42.

Article K **HAM RADIO**

WE SHIP WORLDWIDE

Barry Electronics Corp.

WORLD WIDE AMATEUR RADIO SINCE 1950

Your one source for all Radio Equipment!

For the best buys in town call:
212-925-7000
Los Precios Mas Bajos en Nueva York
WE SHIP WORLDWIDE!

"March into BIG SPRING SAVINGS at BARRY'S"
See you March 5th—WECA, Valhalla, NY

KITTY SAYS: WE ARE NOW OPEN 7 DAYS A WEEK.
Saturday & Sunday 10 to 5 P.M.
Monday-Friday 9 to 6:30 PM Thurs. to 8 PM
Come to Barry's for the best buys in town.

ONV Safety belts-in stock

YAESU

FT-767GX, FT-757GXII, FT-747GX, FRG-8800, FT-736, FRG-9600, FT-4700RH, FT 212/712RH.

ICOM

IC-R71A, 751A, 781, 28A/H, 38A, 48A, Micro2/4, R-7000, IC-761, IC-375A, 275A/H, 3210A, 475A/H, 735, IC-900, IC-228H, IC448A, IC725

SMART PATCH

CES Simplex Autopatch 510 SA Will Patch FM Transceiver To Your Telephone Great For Telephone Calls From Mobile To Base Simple To Use. 510SA/510SAII

PRIVATE PATCH V, Duplex 8000

KENWOOD

Antennas
A-S, AES, Cushcraft, Hy-Gain, Hustler, KLM, METZ, Mosley, MODUBLOX, TONNA, Butternut

TS440S/AT, R-5000, R-2000, TS-940 S/AT, TM 221A/421A, TM-2570A/50A/30A, TR-751A, Kenwood Service Repair, TM-721A, TS-711/811A, TM3530A, TH205AT, TH215A, TM-621A, TM-321A, TS140S, TS680S, RZ-1, TS-790A.

YAESU	ICOM
FT-23/73/33/727R	IC2AT/12AT
FT411-811	IC02AT/32AT
FT-1903/1123	IC2/4GAT
FTH-2005/7005	IC-A2/U16

Landmobile HT's
ICOM: U16, H16, V100, U400
MAXON, MOTOROLA,
YAESU: FTH 2005/2007
UNIDEN, REGENCY, KING, TAD
MARINE ICOM: M5, M55, M700
AVIATION ICOM: A20 H T

RF Concepts

TUNERS STOCKED:
NYE MBV-A 3 Killowatt Tuner

MFJ-989C

Budwig ANT. Products
NEL-TECH DVK-100 Digital Voice Keyer
FLUKE 77 Multimeter
Media Mentors—
Amateur Radio Course $99.95

VoCom/Mirage/Alinco
Tokyo Hy-Power/TE SYSTEMS
Amplifiers &
5/8λ HT Gain
Antennas IN STOCK

MICROLOG-ART 1, Air Disk, SWL, Morse Coach
Soldering Station 48 Watts $68.

Computer Interfaces Stocked: MFJ-1270B MFJ-1274, MFJ-1224, AEA PK-88, MFJ-1278, PK-232 W/FAX.

ALINCO
DJ-500T, DR-110T

FREQUENCY COUNTERS: 1MHz-1.3GHz $169.95

COMMERCIAL & HAM REPEATERS STOCKED. WRITE FOR QUOTES

KANTRONICS
UTU, KAM, UTU-XT, KPC 2400, KPC IV, KAM

MOTOROLA AUTHORIZED DEALER
KACHINA COMMUNICATIONS DEALER

Ten-Tec Tuner 229B

AR 900 Hand Held Scanner 100 ch. Covers 27-54, 108-174, 406-512, 800-950 MHz $299

SHORTWAVE RECEIVERS STOCKED

DIGITAL FREQUENCY COUNTERS
Opto electronics model 1300H, 0-1300MHz

COMET ANTENNAS STOCKED

METRON MA-1000 B STOCKED

HEIL EQUIPMENT IN STOCK

Long-range Wireless Telephone for export in stock

SANGEAN Portable Shortwave Radios

EIMAC
3-500Z
572B, 6JS6C
12BY7A &
6146B

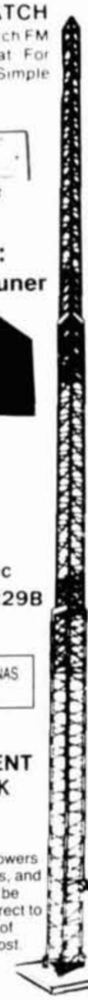
BIRD
Wattmeters &
Elements
In Stock

AEA 144 MHz
AEA 220 MHz
AEA 440 MHz
ANTENNAS

BENCHER PADDLES, BALUNS, LOW PASS FILTERS IN STOCK

MIRAGE AMPLIFIERS
ASTRON POWER SUPPLIES
Saxton Wire & Cable, Int'l Wire

New TEN-TEC Corsair II, PARAGON, OMNI V



Hy-Gain Towers & Antennas, and Rotors will be shipped direct to you FREE of shipping cost.

IIX Towers, Antennas, Mobile Radio mounts stocked. Call.

AMERITRON AUTHORIZED DEALER

MAIL ALL ORDERS TO: **BARRY ELECTRONICS CORP., 512 BROADWAY, NEW YORK CITY, NY 10012 (FOUR BLOCKS NORTH OF CANAL ST.)**

New York City's LARGEST STOCKING HAM DEALER COMPLETE REPAIR LAB ON PREMISES

"Aqui Se Habla Espanol"

BARRY INTERNATIONAL TELEX 12-7670
MERCHANDISE TAKEN ON CONSIGNMENT FOR TOP PRICES

Monday-Friday 9 A.M. to 6:30 P.M. Thursday to 8 P.M.
Saturday & Sunday 10 A.M. to 5 P.M. (Free Parking)

IRT/LEX-"Spring St. Station". **Subways:** BMT-"Prince St. Station". IND-"F" Train-Bwy Station"
Bus: Broadway #6 to Spring St. Path-9th St./6th Ave. Station.

COMMERCIAL RADIOS STOCKED: ICOM, Motorola, MAXON, Standard, Yaesu. We serve municipalities, businesses, Civil Defense, etc. Portables, mobiles, bases, repeaters...

ALL SALES FINAL

We Stock: AEA, ARRL, Alinco, Ameco, Ameritron, Antenna Specialists, Astatic, Astron, B&K, B&W, Bencher, Bird, Butternut, CDE, CES, Cushcraft, *Daiwa, Eimac, Henry, Heil, Hustler, Hy-Gain, Icom, KLM, Kantronics, Larsen,* MJF, J.W. Miller, Mirage, Nye, Palomar, RF Products, Saxton, Shure, Tempo, Ten-Tec, TUBES, Yaesu, Vibroplex, Duplexers, Repeaters, Scanners, Radio Publications, Uniden, Kenwood, Maxon, RFC.

WE NOW STOCK COMMERCIAL COMMUNICATIONS SYSTEMS

HAM DEALER INQUIRES INVITED PHONE IN YOUR ORDER & BE REIMBURSED

COMMERCIAL RADIOS stocked & serviced on premises.

Amateur Radio Courses Given On Our Premises, Call

Export Orders Shipped Immediately. TELEX 12-7670

FAX: 212-925-7001

New gear for the satellite communicator.

The Kenwood TS-790A covers 144, 450, and 1200 MHz with enhancements like Doppler shift compensation for the VHF, UHF, and satellite "power user." Automatic Lock Tuning (ALT) on 1200 MHz eliminates frequency drift. Power output is 45 watts on 144 MHz, 40 watts on 450 MHz, and 10 watts on 1200 MHz. (The 1200-MHz section is an optional module.) The TS-790A is pending FCC approval.

TS-790A features include:

- High stability VFO.
- 59 multi-function memory channels.
- Operation on 13.8 Vdc.
- Multiple scanning and scan stop functions.
- 500-Hz CW filter built in.
- Interference reduction controls.
- Packet radio terminal.
- CTCSS encoder built in.
- Mode switch confirmation of USB, LSB, CW, or FM selection with Morse Code.
- Dual Watch for reception of two bands at the same time.
- Automatic mode and automatic repeat offset selection.
- Direct keyboard frequency entry.
- Voice synthesizer and computer control option.

The retail price of the TS-790A is $1999.95. For more information contact Kenwood, 2201 E. Dominquez Street, Long Beach, California 90810.

UAI-10 Universal Audio Interface

The Creative Control Products UAI-10 Universal Audio Interface board is a low cost, easy to interface repeater and link audio mixer featuring DTMF mute, and link monitor-mix control.

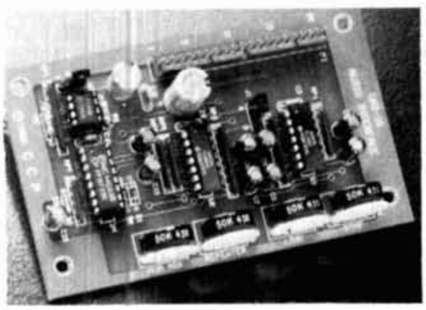
Audio inputs are: repeater, link, control receiver, CW-Tone, and an auxiliary input for other audio sources like a local microphone. Audio outputs are: repeater, link, and a DTMF output for the DTMF decoder on your controller. Each audio output is adjustable to the level required by your system.

Control inputs to the UAI-10 consist of repeater COS (which is selectable high or low), DTMF mute, and an auxiliary output from your controller for the link mute function.

The UAI-10 has provisions to mute the DTMF tones from the repeater transmit audio. The ability to mute or pass DTMF tones out the link transmit audio is provided via a jumper on the circuit board.

Normally full audio is present at the repeater transmitter audio output. Whenever the repeater COS is activated, both the repeater and link audio are mixed together resulting in the condition called Monitor-Mix. This monitor-mix audio is adjustable so that the link receiver audio can be lower in volume than the repeater receiver audio. Also, whenever the auxiliary control input is activated, the link receive audio will be completely muted upon repeater COS activity. Either mute or monitor-mix operation is selectable so that normal repeater receiver audio will not be overpowered by the link receiver's audio.

Each UAI-10 comes assembled and tested and carries a one-year warranty. The UAI-10, with manual is available for immediate shipment at an introductory price of $44.00.



For more information on the UAI-10, contact Creative Control Products, 3185 Bunting Avenue, Grand Junction, Colorado, 81504 (303) 434-9405.

Circle #301 on Reader Service Card.

New dealers announced

Kantronics, Inc. announces the appointment of Associated Radio of Overland Park, Kansas and Rivendale Electronics of Derry, New Hampshire as new Amateur dealers for the Kantronics line of Amateur Radio products.

For more information, please contact: Kantronics, Inc. 1202 E. 23rd Street, Lawrence, Kansas 66046.

PC HF FAX facsimile reception system for IBM PC™ computers

Software Systems Consulting has announced a new way to receive facsimile information from HF SSB receivers using an IBM™ or compatible personal computer. The HF FAX system produces images with gray scale or color. The system contains everything you need to connect your computer and your HF receiver. It consists of an A/D demodulator cable, software, instruction manual, and tutorial tape cassette.

Minimum system requirements are: an HF SSB receiver; an IBM PC or true compatible; MS DOS 2.1 or higher; 384K RAM; a Hercules, CGA, or EGA video adapter card; and a serial port. A parallel printer and an audio cassette player are optional.

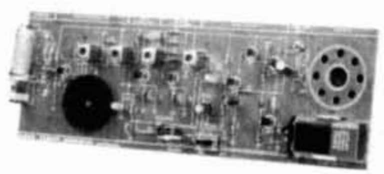
The PC HF FAX software is menu driven and has a tuning scope feature for FAX capture. The scan rate is variable to allow for the different types of FAX transmissions found on HF (ie., Weather FAX, news wire services, etc.). Once the parameters are set to match transmission rates to the computer's internal clock, the "auto mode" can be used to detect the beginning of a new transmission, capture it, and save to disk for future use.

PC HF FAX sells for $79.95, and is available from Software Systems Consulting, Amateur Radio Group, 1303 S. Ola Vista, San Clemente, California 92672.

Circle #302 on Reader Service Card.

"Super heterodyne" receiver

The Elenco Superhet 550 AM Radio Kit is a "super heterodyne" receiver of standard AM (amplitude modulated) broadcast frequencies. It uses seven transistors. The Superhet 550 lets you place parts over their corresponding symbols in the schematic drawing on the surface of the printed circuit board during assembly. This maximizes the learning process and keeps the chances of assembly error at a minimum.



An assembly, lesson, and theory of operation manual is included. Priced at $19.95, the Superhet 550 makes an excellent project for classroom studies.

For additional information contact Elenco Electronics, Inc., 150 West Carpenter Avenue, Wheeling, Illinois 60090.

Circle #303 on Reader Service Card.

RAMSEY ELECTRONICS

Quality Test Gear & Electronic Kits for Professionals and Hobbyists

ALL NEW KITS

COM-3

$2495.00 THE COMMUNICATIONS SERVICE MONITOR THAT WORKS HARDER FOR LESS.

Introducing COM-3... the new service monitor designed by service technicians for service technicians. It works harder for less... giving you advanced testing capabilities at a very affordable price. FEATURES • Direct entry keyboard with programmable memory • Audio & transmitter frequency counter • LED bar graph frequency/error deviation display • 0.1-10,000 μv output levels • High receive sensitivity, less than 5 μv • 100 KHz to 999.9995 MHz Continuous frequency coverage • Transmit protection, up to 100 watts • CTS tone encoder, 1 KHz and external modulation

PR-2 COUNTER PREAMP

$49.95 wired includes AC adapter
PR-2 kit **$39.95**

The PR-2 is ideal for measuring weak signals from 10 to 1,000 MHz • flat 25 db gain • BNC connectors • great for sniffing RF • ideal receiver/TV preamp • 3 db NF

PS-2 AUDIO MULTIPLIER

$69.95 wired
PS-2 kit **$49.95**

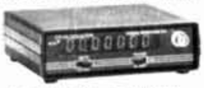
The PS-2 is handy for high resolution audio resolution measurements, multiples Up in frequency • great for PL tone measurements • multiples by 10 or 100 • 0.01 Hz resolution & built-in signal preamp/conditioner

PS-10B 1.5 GHz PRESCALER

$89.95 wired includes AC adapter

Extends the range of your present counter to 1.5 GHz • 2 stage preamp • divide by 1000 circuitry • super sensitive (50 mV typical) • BNC connectors • 1.5 GHz in, 1.5 MHz out • drives any counter.

CT-70 7 DIGIT 525 MHz



$139.95 WIRED, INCLUDES AC ADAPTER

CT-90 9 DIGIT 600 MHz

$169.95 WIRED INCLUDES AC ADAPTER

CT-50 8 DIGIT 600 MHz

$189.95 WIRED INCLUDES AC ADAPTER

CT-125 9 DIGIT 1.2 GHz

$189.95 WIRED INCLUDES AC ADAPTER

FREQUENCY COUNTERS

Ramsey Electronics has been manufacturing electronic test gear for over 10 years and is recognized for its lab quality products at breakthrough prices. All of our counters carry a full one year warranty on parts and labor. We take great pride in being the largest manufacturer of low cost counters in the entire USA. Compare specifications. Our counters are full featured, from audio to UHF, with FET high impedance input, proper wave shaping circuitry and durable high quality epoxy glass, plated-thru PC Board construction. All units are 100% manufactured in the USA.

ACCESSORIES FOR COUNTERS

Telescopic whip antenna—BNC plug	$ 8.95
High impedance probe, light loading	16.95
Low pass probe, audio use	16.95
Direct probe, general purpose use	13.95
Tilt bail for CT-70, 90 & 125	3.95
Nicad pack for CT-70, 90 & 125	8.95

MODEL	FREQ RANGE	SENSITIVITY	ACCURACY	DIGITS	RESOLUTION	PRICE
CT-70	20 Hz-550 MHz	< 50 mv To 150 MHz	1 PPM	7	1 Hz, 10Hz, 100Hz	139.95
CT-90	10 Hz-600 MHz	< 10mv To 150 MHz < 150mv To 600 Mhz	1 PPM	9	0.1Hz, 10Hz, 100 Hz	169.95
CT-50	5 Hz-600 MHz	LESS THAN 25 mv	1 PPM	8	1Hz, 10Hz	189.95
CT-125	10 Hz-1.25 GHz	< 25mv @ 50 MHz < 15mv @ 500 MHz < 100mv @ 800 MHz	1 PPM	9	0.1Hz, 1Hz, 10Hz	189.95
CT-90 WITH OV-1 OPTION	10 Hz-600 MHz	< 10mv To 150 MHz < 150mv To 600 MHz	0.1 PPM	9	0.1Hz, 1Hz, 10Hz	229.90

MINI KITS—EASY TO ASSEMBLE—FUN TO USE

TONE DECODER
A complete tone decoder on a single PC board. Features: 400-5000 Hz adjustable range via 20 turn pot, voltage regulation, 567 IC. Useful for touch-tone burst detection, FSK, etc. Can also be used as a stable tone encoder. Runs on 5 to 12 volts.
Complete kit, TD-1 **$5.95**

COLOR ORGAN
See music come alive! 3 different lights flicker with music. One light each for high, mid-range and lows. Each individually adjustable and drives up to 300 W, runs on 110VAC.
ML-1 Kit **$8.95**

VIDEO MODULATOR
Converts any TV to video monitor. Super stable, tunable over ch 4-6. Runs on 5-15V, accepts std. video signal. Best unit on the market! Complete kit, VD-1 **$7.95**

FM WIRELESS MIKE
Transmits up to 300' to any FM broadcast radio, uses any type of mike. Runs on 3 to 9V. Type FM-2 has added sensitive mike preamp stage.
FM-1 Kit **$3.95**
FM-2 Kit **$4.95**

LED BLINKY KIT
Alternately flashes 2 jumbo LEDs. Use for name badges, buttons, warning panel lights. Runs on 3 to 15 volts.
BL-1 Kit **$2.95**

MAD BLASTER
Produces LOUD ear shattering and attention getting siren like sound. Can supply up to 15 watts of obnoxious audio. Runs on 6-15 VDC.
MB-1 Kit **$4.95**

40 WATT 2 mtr PWR AMP
Simple Class C power amp features 8 times power gain: 1 W in for 8 out, 2 W in for 15 out, 5 W in for 40 W out. Max output of 50 W, incredible value, complete with all parts, less case and T-R relay.
PA-1, 40 W pwr amp kit **$27.95**
TR-1, RF sensed T-R relay kit **6.95**

VOICE ACTIVATED SWITCH
Voice activated switch kit provides switched output with current capability up to 100 mA. Can drive relays, lights, LED or even a tape recorder motor. Runs on 9 VDC.
VS-1 KIT **$6.95**

UNIVERSAL TIMER
Provides the basic parts and PC board required to provide a source of precision timing and pulse generation. Uses 555 timer IC and includes a range of parts for most timing needs.
UT-5 Kit **$5.95**

WHISPER LIGHT
An interesting kit, small mike picks up sounds and converts them to light. The louder the sound, the brighter the light. Includes mike, controls up to 300 W, runs on 110 VAC.
WL-1 Kit **$6.95**

SIREN
Produces upward and downward wail. 5 W peak audio output, runs on 3-15 volts, uses 3-45 ohm speaker.
Complete kit, SM-3 **$2.95**

SUPER SLEUTH
A super sensitive amplifier which will pick up a pin drop at 15 feet! Great for monitoring baby's room or as general purpose amplifier. Full 2W rms output, runs on 6 to 15 volts, uses 8-45 ohm speaker.
BN-9 Kit **$5.95**

60 Hz TIME BASE
Runs on 5-15 VDC. Low current (25ma). 1 min/month accuracy.
TB-6 Kit **$5.50**
TB-6 Assy **$9.95**

TELEPHONE TRANSMITTER
Low cost with professional performance. Features include: self phone line powered, tunable from 76 to 100 MHz, polarity antisensitive, compact size (1" x 1½"), easily installs anywhere on the phone line or inside the instrument itself.
PB-1 KIT **$14.95**

FM RECEIVER
For built-in applications or hobby experimentation. Full fledged superhetrodyne receiver, microvolt sensitivity, 10.7 MHz IF. Integrated Circuit detector, 50 mw audio amplifier, 9V external power source, operation on standard FM broadcast band as well as large portions on each side, compact (6" square), for bug detection or reception.
FR-1 KIT **$14.95**

FM MINI MIKE
A super high performance FM wireless mike kit! Transmits a stable signal up to 300 yards with exceptional audio quality by means of its built in electret mike. Kit includes case, mike, on-off switch, antenna, battery and super instructions. This is the finest unit available.
FM-3 Kit **$14.95**
FM-3 Wired and Tested **19.95**

NEW

MICROWAVE INTRUSION ALARM
A real microwave doppler sensor that will detect a human as far as 10 feet away. Operates on 1.3 GHz and is not affected by heat, light or vibrations. Drives up to 100 ma output, normally open or closed, runs on 12 VDC.
Complete Kit, MD-3 **$16.95**

NEW

SPEECH SCRAMBLER
Communicate in total privacy over your telephone or radio. This scrambler kit features full duplex operation using frequency inversion. Runs on a 9 volt battery. Both mike and line or speaker output/inputs. Easy to connect to any radio—telephone use requires no direct connection! Easy to build, uses IC DBM circuitry. Can also be used to descramble most com. scramblers.
Complete kit, SS-7 **$29.95**
Case kit, CSS-7 **12.95**

PERSONAL SPEED RADAR

Complete kit SG-7 **$89.95**

New low cost microwave doppler radar kit "clocks" cars, planes, boats, horses, bikes, baseballs, models, runners or virtually anything that moves. Operates at 2.6 GHz with over 1/4 mile range. LED digital readout displays speeds in miles per hour, kilometers per hour or feet per second! Earphone output permits listening to actual doppler shift. Uses two 1 lb coffee cans for antenna (not included) and runs on 12 VDC. Easy to build—all microwave circuitry is PC stripline. Kit includes deluxe ABS plastic case with speedy graphics for a professional look. A very useful and full-of-fun kit.

RADIOS

40 & 80 METERS HAM RECEIVERS

Sensitive all mode: AM, CW, SSB receivers for 3.5—4.0 or 7.0—7.5 MHz. Direct conversion design using NE602 IC as featured in QST and ARRL handbooks. Less than 1 μv sensitivity, varactor diode tuned, 50 mw audio output. Runs on 9VDC, has RF gain control. This kit is very easy to build, lots of fun and educational—ideal for the beginner or the old pro. The optional matching case kit features a rugged ABS plastic case with screened graphics. Included are machined aluminum knobs for a well-finished professional look.

40 Meter receiver kit, HR-4 **$24.95** 80 Meter receiver kit, HR-8 **$24.95** Receiver case kit, CHR **$12.95**

QRP TRANSMITTER KITS, 40 & 80 METERS

Operate a mini ham shack. These little CW rigs are ideal mates to our 40 and 80 meter receivers. Features include smooth variable tuning, one watt output and excellent keying characteristics. Runs on 12 VDC and is VSWR protected. See how far you can stretch your signal with one of these mini rigs. Optional ABS cases are available.

40 meters QRP rig, QRP-40 **$24.95** 80 meters QRP rig, QRP-80 **$24.95** Case kit CQRP **$12.95**

AIRCRAFT RECEIVER KIT

Hear exciting aircraft communications—picks up planes up to 100 miles away. Receives 110—136 MHz AM air band, varactor tuned superhet design with AGC, ceramic filter and adjustable squelch. Runs on 9V battery, 50 mw audio output, 1 μv sensitivity. Optional matching ABS plastic case lets you take it anywhere, features screened graphics and machined aluminum knobs for a real professional look. Compact—great for airshows or for just plain hanging around the airport.

Complete kit, AR-1 **$24.95** Receiver case kit, CAR-1 **$12.95**

SHORTWAVE RECEIVER KIT

A fantastic receiver that captures the world with just a 12" antenna! Receives 4—11 MHz in 2 MHz bands, varactor tuned, superhet design with AGC, RF gain control, and 50 mw audio output. Uses new Signetics mixer chip for less than a microvolt sensitivity, runs on 9V battery. This is a fascinating scout, school or club project, and will provide hours of fun even to the most serious DX er. Add the optional case kit and you have a real nice looking shortwave set.

Complete kit, SR-1 **$24.95** Receiver case kit, CSR-1 **$12.95**

PACKET RADIO

Commodore C64/128 packet radio interface. Uses famous German Digicom software. Features EXAR IC chip set for reliable operation—runs HF or VHF tones. Includes FREE disk software, PC board, all necessary parts and full documentation.

Complete kit: PC-1 **$49.95**

FM COMMUNICATIONS/2 METER RECEIVER

Sensitive superhet FM receiver tunes any 5 MHz segment from 135—175 MHz. Listen to 2 mtr ham operations, high band police calls, weather or mobile phone calls! Easy to build receiver features varactor tuning, IC mixer stage, ceramic IF filters and dual conversion design with adjustable squelch. Less than 1 μv sensitivity, runs on 9 V battery, with 50 mw audio output. Optional ABS case with screened graphics and machined aluminum knobs provide a nice professional look.

Complete kit, FR-7 **$29.95** Receiver case kit, CFR-7 **$12.95**

NEW MINIKITS—NEW MINIKITS

BROADBAND PREAMP

A sensitive all purpose preamp, ideal for scanners, TV sets, VHF UHF rigs, counters, etc. Features low noise, 4 db NF, 20 db gain, 100 KHz—1 GHz operation. Runs on 9—12 VDC, 50 ohms input.

Complete kit, SA-7 **$12.95**

LIGHT BEAM COMMUNICATORS

Transmits modulated infrared light up to 30 feet without lenses, up to 1/4 mile using lenses. Uses 30 KHz carrier for hum-free operation, transmits thru windows, etc. Ideal for "bugs" or listening to IR remote controls. Transmitter has sensitive mike input, receiver uses PIN detector and drives speaker output. Units operates on 9—12 VDC.

Transmitter kit, LB-6 **$8.95**
Receiver kit, LB-5 **$9.95**

HIGH POWER FM WIRELESS MIKE

A high power unit that will transmit up to 1/2 mile to any FM broadcast radio. Sensitive input accepts any type of mike, will pick up normal voices 10 feet away using the available mini-electric mike cartridge. Operates on 9—12 VDC.

FM-4 kit **$9.95**
Sensitive microphone cartridge **$2.95**

2 MTR & 220 BOOSTER AMP

- 30 WATTS OUTPUT
- LOW NOISE PREAMP
- LOW COST
- RUGGED CAST ALUMINUM CASE
- ONE YEAR WARRANTY

Here's a great booster for any 2 meter or 220 MHz hand-held unit. These power boosters deliver over 30 watts of output allowing you to hit the repeaters full quieting while the low noise preamp remarkably improves receptions. Ramsey Electronics has sold thousands of 2 mtr amp kits but now, we offer completely wired and tested 2 mtr as well 220 MHz units. Both have all the features of the high priced boosters at a fraction of the cost.

PA-10 2 MTR POWER BOOSTER (10 X power gain) Fully wired & tested $59.95
PA-20 220 MHz POWER BOOSTER (8 X power gain) Fully wired & tested $59.95

MasterCard VISA

TERMS: • satisfaction guaranteed • examine for 10 days; if not pleased, return in original form for refund • add 6% for shipping and insurance to a maximum of $10.00 • foreign add 15% for surface mail • COD add $2.50 (COD in USA only) • orders under $20.00 add $1.50 • NY residents add 7% sales tax • 90 days parts warranty on all kits • 1 year parts & labor warranty on all wired units.

RAMSEY ELECTRONICS, INC., 2575 Baird Rd., Penfield, N.Y. 14526

PHONE ORDERS CALL 716-586-3950

FAX 716-586-4754

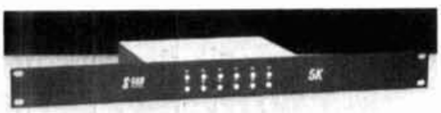
New display cabinet option

S-COM Industries has a new display cabinet option for its 5K Repeater Controller. The cabinet may be retrofitted to any 5K controller without soldering or rewiring.

The display cabinet has a non-chipping black anodized front panel, white graphics, and hidden fasteners to eliminate unsightly screw heads and other hardware.

Large, red Hewlett-Packard AlGaAs LED lamps give circuit status data (i.e., Receiver COR, Transmitter PTT, CTCSS Decoder, Control Receiver COR, DTMF Data Valid, Power On, Logic Inputs 1, 2, 3, and Logic Outputs 1, 2, and 3). The LEDs feature high light output while consuming 1 mA each.

A conductive iridite-plated chassis box reduces RFI and houses the 5K board, display Board, and an optional Audio Delay Module.



The cabinet has cutouts for the 5K's power and input/output connectors, and uses PEM fasteners to eliminate nuts and standoffs. A ribbon cable assembly attaches to connectors located on the 5K and display boards for easy installation.

The assembled and tested display cabinet is priced at $69 plus $5 shipping and handling. A similar cabinet is available without the display feature. Contact S-Com Industries, P.O. Box 8921, Fort Collins, Colorado 80524. Telephone 303-493-8316.

Circle #304 on Reader Service Card.

NP1055

New book explains different communication modes

Advanced Electronic Applications has just released its new publication for Radio Amateurs interested in digital communication, *Digital Communications With Amateur Radio*. It gives a basic understanding of many different communication modes, with major emphasis on packet radio. The 160-page paperback uses dozens of illustrations to make difficult subjects easy to understand.

In addition to theoretical explanations, *Digital Communications With Amateur Radio* gives hands-on examples of computer-to-radio interfacing. This book is perfect for both the Radio Amateur and computer hobbyist.

AEA created this special book in cooperation with Master Publishing of Richardson, Texas. The original book was written for, and is available from, Radio Shack. The AEA book is available through AEA authorized dealers and *Ham Radio* Bookstore. This book is an excellent source of packet information most requested by Radio Amateurs. The suggested retail price is $9.95 (plus $3.50 shipping and handling from *Ham Radio* Bookstore).

For more information contact Advanced Electronic Applications, Inc., P.O. Box C2160, Bldg. O & P, 2006 196th SW, Lynnwood, Washington 98036-0918.

Circle #305 on Reader Service Card.

New all-mode transceiver from Heath

Heath Company has introduced the SB-1400 All-Mode Transceiver. This new transceiver provides all-band, all-mode coverage and 100 watts of transmit power.

The SB-1400 is sold assembled at a suggested net price of $799.95. (Product specifications and prices are subject to change without notice.)

Available accessories include: a 20-amp power supply with built-in speaker, an FM module, handheld microphone, mobile bracket, and a switching relay that may be required for some linear amplifiers.

The SB-1400 comes with after-sale support through the 70 Heath/Zenith stores in the U.S. and Canada, or direct from the factory. The transceiver also comes with an industry-recognized user's manual. To order the SB-1400, call toll-free 1-800-253-0570.

For a complete listing of products, write for the Heathkit catalog at: Heath Company, Department 350-036, Benton Harbor, Michigan 49022 or call toll-free 1-800-44-HEATH.

New dealer and distributor announced

Kantronics, Inc. has appointed RJM of Boise, Idaho as a new dealer for the Kantronics line of Amateur Radio products and Morocom, Inc. of Alexandria, Virginia as a Kantronics distributor for countries like Peru, Boliva, Ecuador, Columbia, and Mexico.

For more information, please contact: Kantronics, Inc. 1202 E 23rd Street, Lawrence, Kansas 66046.

New full-function software package

The Amateur Radio Operating System (ARS), written by Ron Stange, WA4PYF, is a modular software system for IBM PC and compatibles. It is a full-function software package for both Novices and seasoned Amateur Radio operators.

ARS software is offered in functional modules. After purchasing the BASE module, you need only buy those modules that support your own field of interest.

The ARS base module can be ordered for $39.95 to Fundamental Services, Dept R, 1546 Peaceful Lane N., Clearwater, Florida 34616. Florida residents add $2.40 sales tax. Demonstration diskettes are available for $10, discounted on the next purchase.

Dealer and distributor inquiries are invited.

Yaesu USA creates design team of Amateur Radio operators

Yaesu USA invites Amateur Radio operators to apply for the company's special design advisory council. They will meet with Yaesu's management staff Wednesday, June 14 throughFriday, June 16, 1989.

The operators will be asked what features they'd like to see in Amateur Radio equipment. Eleven applicants will be chosen — one from each call district and one at Dayton HamVention '89. Yaesu will fly those selected to Southern California. The team will stay at the Disneyland Hotel, tour the Jet Propulsion Laboratory, and receive passes to Disneyland.

The first ten members will be chosen from applications postmarked by April 7, 1989. The last team member will be selected from applications turned in by April 29 at the Yaesu booth at HamVention '89 in Dayton, Ohio.

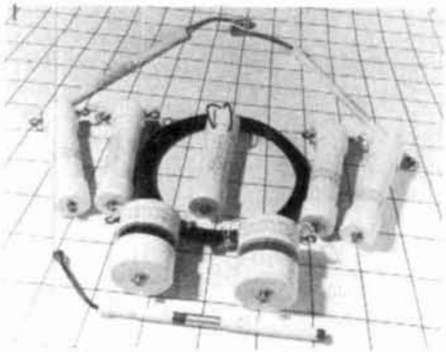
For more information or to obtain an application form, call (800) 999-2070, or write to Yaesu Council, Yaesu USA, 17210 Edwards Road, Cerritos, California 90701.

NEW products

New, comprehensive, balun line

The RADIO WORKS has announced its comprehensive new balun line.

Three models have 4:1 ratios. The B4-1.5K is a general purpose, 80 to 10 meter, ferrite balun. The B4-2K is a wide-band, L-C compensated, ferrite-toroid balun. The B4-2KX is a twin toroid core, L-C compensated design with good output balance and wide operating bandwidth. The power rating is well beyond the legal limit. All models have exceptional electrical specifications, output balance and very high transmission line isolation.



There are 5 models in the 1:1 balun line. The three "C-series" baluns are designed for retrofit applications in wire antennas and beams from 160 through 10 meters. The C1-2K is a 50-ohm low-loss balun; the C75-2K and the C75-4K are 75-ohm models. All have unusually high transmission line isolation and excellent output balance.

The B1-2K and B1-4K are suitable for use with wire antennas of all types. They are "current-type," wide-band, low-loss designs.

The RemoteBalun™ and a Line Isolator™ are two special models. The 4K-LI Line Isolator is useful for preventing RF current from entering the hamshack and causing RF feedback problems. The 4K-LI is available in 50 and 75 ohm models.

The RADIO WORKS RemoteBalun solves the problem of getting open-wire or ladder-line into the ham shack. The RemoteBalun is mounted outside where it connects to the antenna's ladder-line or open-wire transmission line. A short length of special, low-loss, coaxial cable connects the RemoteBalun to your transmatch.

All RADIO WORKS baluns feature rugged cases. Soldered internal connections, and leads are brought outside the case for direct connection to the antenna wire. Each balun is completely potted. Prices begin at $15.95.

For more information write: The Radio Works at Box 6159, Portsmouth, Virginia 23703. An catalog featuring a wide selection of wire antennas, parts, accessories is available.

Circle #306 on Reader Service Card.

NP1080

Self-learning package makes it easy to upgrade

Radio Shack's new General Class-FCC License Preparation package contains everything you need to upgrade from Technician to General Class.

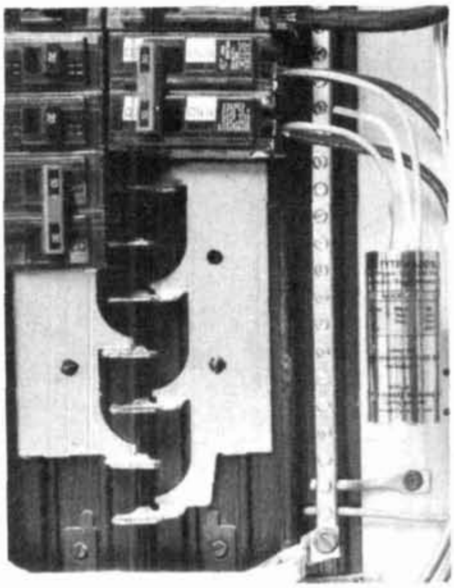
Included are:

- Examination test questions and answers
- Two code tapes for speed building from 5-13 wpm
- Explanation of correct test answers
- Helpful study hints
- FCC form 610 application
- ARRL application

Published by Master Publishing, the New General Class package is available in Radio Shack stores for $19.95.

Surge and lightning arresters

Tytewadd Power Filters manufactures eight models of UL listed secondary surge and lightning arresters for installation directly inside main or sub-distribution electrical panels. One unit, or unit series, connected into one side of any two or three-pole breaker protects the panel and the entire electrical environment of your premises from surges, spikes, and transients from a moderate 130 volts to lightning-induced surges developing 15,000 amps.



Tytewadd devices clamp in 1.5 nanoseconds, at less than 10 percent above the rated (or provided) voltage performance parameters. This lets them dissipate more moderate surges and spikes continuously.

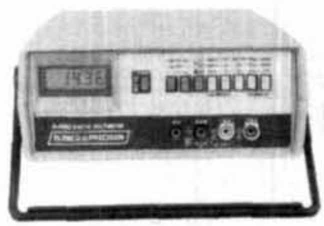
Tytewadd products are warranted for one year, with half-cost replacement thereafter.

For more information contact Tytewadd Power Filters, 704 W. Battlefield Road, Springfield, Missouri 65807.

Circle #307 on Reader Service Card.

Versatile portable multimeter

The Elenco Digital Bench Multimeter Model M-4500 is a versatile 4-1/2 digit portable instrument for use in general electronics maintenance, production, and the laboratory. It has a built-in



battery pack providing 6,000 hours of continuous operation. It features 0.05 percent DCV accuracy, integrated circuit electronics, solid-state LCD display, and push-button switch selection. All VOM functions, plus the versatile diode test and high ohm-low ohm test functions, are standard. Each range has full auto-polarity operation and overrange indication. The meter uses the dual-slope integration measurement technique to insure noise-free measurements.

The unit is priced at $250 and comes complete with operator's manual, test leads, and built-in battery pack. For more information contact Elenco Electronics, Inc., 150 West Carpenter Avenue, Wheeling, Illinois 60090.

Circle #308 on Reader Service Card.

Callbook buys Radio School

Gordon West's Radio School has been purchased by Radio Amateur Callbook Inc. The Radio School is now part of the Callbook operation and the Callbook will handle all future order input and shipment of training courses and code tapes.

Gordon West will continue to develop additional upgrade training books and new code tapes.

Direct all orders and product inquiries to: Radio Amateur Callbook Inc., 925 Sherwood Drive, Box 247, Lake Bluff, Illinois 60044. Students needing to ask "Gordo" any questions about training materials should write or call Gordon West, 2414 College Drive, Costa Mesa, California 92626, 714-549-5000.

Circle #309 on Reader Service Card.

Multi-pair audio "snake" cable

Belden Wire and Cable has a new line of multi-pair audio "snake" cables with individually jacketed and shielded pairs for protection against signal loss. These cables interconnect audio components.

The audio cable series offers eight different pair constructions ranging from 4- to 32-conductor pairs. Each is individually shielded with Beldfoil® for 100-percent coverage against interference. Jacketed with PVC and insulated with polypropylene, this series has 22 AWG (7 × 30) stranded tinned copper conductors. The loose tube construction enables high flexibility. Inner jacketed pairs are numbered for identification.

Available from stock in 100, 250, 500, and 1000-foot put-ups, this audio cable line is priced at $640 for 1000 feet of four-pair cable.

For more information or cable samples, contact Belden Wire and Cable, P.O. Box 1980, Richmond, Indiana, 47375.

Circle #310 on Reader Service Card.

RZ-1 wide-band scanning receiver

The RZ-1 wide-band, scanning receiver covers 500 kHz—905 MHz in AM, and narrow or wide-band FM. The automatic mode selection function makes listening easy. The receiver features one hundred memory channels with message and band marker, direct keyboard or VFO frequency entry, and scanning functions like memory channel and band scan — with four types of scan stop. The RZ-1 is a 12-volt DC-operated, compact unit, with built-in speaker, front-mounted phones jack, switchable AGC, squelch for narrow FM, illuminated keys, and a "beeper" to confirm keyboard operation. The suggested retail price of the RZ-1 is $599.95.

See your authorized Kenwood Amateur Radio dealer for more details, or contact Kenwood, 2201 E. Dominiquez Street, Long Beach, California 90810.

"Digalert" TNC message indicator

JComm has introduced an accessory for most popular TNCs to alert the operator visually if a message is waiting in the TNC's memory. This device plugs in series with your RS-232 cable with no modifications. When another station connects, an LED turns on and remains lit until you press the reset button on the front panel.

The "Digalert" is priced at $25. To order, or for more information, write to JComm, P.O. Box 5647, Boise, Idaho 83705.

Circle #311 on Reader Service Card.

Miniaturized gripper test connector

E-Z Hook has introduced the E-Z Micro Double Gripper Test Connector series.

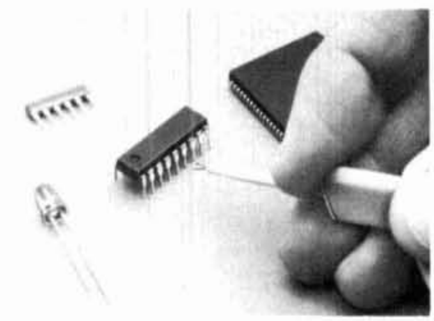
The Double Gripper XK series features a dual-contact blade assembly that opens and closes in a single extension step by depressing the unit's plunger. A gripping hook, built into the retractable stainless steel blades, provides secure, electrically continuous contact with the test object or other items. Both housing and plunger are molded of durable nylon.

The Double Gripper is 0.175" thick at its widest point. A probe-style tip, including the housing, measures only 2.125" long, and 0.525" high. The unit accepts 22 AWG test lead wire.

An assortment set of 10 individually color-coded XK Double Gripper units (part no. XK-S) is available, plus over 110 E-Z Micro Double Gripper Test Lead assemblies.

Complete specifications on the XK series, pricing, and all standard E-Z Hook products are available in a 112-page catalog. Contact E-Z Hook, Division Tektest, Inc., P.O. Box 450, 225 N. Second Avenue, Arcadia, California 91106-0450.

Circle #312 on Reader Service Card.



RC-1000 repeater controller

Micro Computer Concepts has introduced the RC-1000 — a complete repeater controller with on-board interfacing for the receiver/transmitter. It also features an autopatch with direct-connect phone line for pulse or touch tone dialing, a remote base or tape player, CW ID, and complete control and user touch-tone codes. Six pots allow for independent adjustment of all audio interfaces between the repeater receiver, transmitter, and phone line.

The heart of the RC-1000 is an Intel 8751 microcomputer containing 4K of EPROM, 128 bytes of RAM, and 32 programmable I/O pins. You can control the RC-1000 through the repeater receiver, or phone line callin. Touch-tone decoding is performed by a Mitel 8870 single-chip DTMF decoder.

The complete controller is contained on one 5.3" × 3.6" pc board. It requires 12 volts DC or AC, with separate inputs for a battery and transformer. Diode isolation is provided permitting direct connect of a battery with automatic switching when AC power is lost.

The RC-1000 comes wired and tested for $219.95. The price includes manuals and schematic. The unit is distributed by R&L Electronics, Hamilton, Ohio.

Circle #313 on Reader Service Card.

High-speed 4800-baud modem

Hamilton and Area Packet Network (HAPN) has designed a plug-in 4800-baud modem for the TAPR TNC-1 and TNC-2 and many of its clones. This modem increases normal packet operation to four times the speed of the standard 1200-baud modem. Additional speed performance is achieved by a fast-acting modem squelch (about 15 mS).

The modem uses direct FM biphase modulation and doesn't require a randomizer or synchronization burst. There's no DC component in the encoded data, making it possible to use regular FM/PM synthesized or crystal-controlled voice radios. The required bandwidth is the same as for voice. The simple hookup to the radio's discriminator and modulator avoids the distortion normally caused by the mike preamplifier, limiter, emphasis, de-emphasis, and receive audio amplifier. Reliability is generally better than 1200-baud modems using the radio's mike and speaker connections. Radio voice operation isn't affected with the new interface installed.

The HAPN-T daughter board plugs into the external modem connector of the TNC. It's small size 9.5 × 7 cm (3.75 × 2.75 inches) allows it to be mounted inside almost any TNC. The power for the modem is taken from the + 12 volts inside the TNC.

HAM MART

Ham Radio's guide to help you find your loca

California

A-TECH ELECTRONICS
1033 HOLLYWOOD WAY
BURBANK, CA 91505
(818) 845-9203
New Ham Store and Ready to Make a Deal!

JUN'S ELECTRONICS
3919 SEPULVEDA BLVD.
CULVER CITY, CA 90230
213-390-8003
800-882-1343 Trades
Habla Espanol

Colorado

ALLIED APPLIANCE & RADIO
4253 SOUTH BROADWAY
ENGLEWOOD, CO 80110
(303) 761-7305
Rocky Mts Amateur/Shortwave Specialists, Ten-Tec, Yaesu, JRC-NRD, Sony , MFJ, KLM, and other fine gear. New and used. Visa/MC. Antennas, books, discount prices too!

COLORADO COMM CENTER
525 EAST 70th AVE.
SUITE ONE WEST
DENVER, CO 80229
(303) 288-7373
(800) 227-7373
Stocking all major lines
Kenwood Yaesu, Encomm, ICOM

Connecticut

HATRY ELECTRONICS
500 LEDYARD ST. (SOUTH)
HARTFORD, CT 06114
203-527-1881
Call today. Friendly one-stop shopping at prices you can afford.

Delaware

AMATEUR & ADVANCED COMMUNICATIONS
3208 CONCORD PIKE
WILMINGTON, DE 19803
(302) 478-2757
Delaware's Friendliest Ham Store.

DELAWARE AMATEUR SUPPLY
71 MEADOW ROAD
NEW CASTLE, DE 19720
302-328-7728
800-441-7008
Icom, Ten-Tec, Microlog, Yaesu, Kenwood, Santec, KDK, and more.
One mile off I-95, no sales tax.

Florida

AMATEUR ELECTRONIC SUPPLY
1898 DREW STREET
CLEARWATER, FL 33575
813-461-4267
Clearwater Branch
West Coast's only full service Amateur Radio Store.
Hours M-F 9-5:30, Sat. 9-3

AMATEUR ELECTRONIC SUPPLY
621 COMMONWEALTH AVE.
ORLANDO, FL 32803
305-894-3238
Fla. Wats: 1 (800) 432-9424
Outside Fla: 1 (800) 327-1917
Hours M-F 9-5:30, Sat. 9-3

Hawaii

HONOLULU ELECTRONICS
819 KEEAUMOKU STREET
HONOLULU, HI 96814
(808) 949-5564
Kenwood, ICOM, Yaesu, Hy-Gain, Cushcraft, AEA, KLM, Tri-Ex Towers, Fluke, Belden, Astron, etc.

Idaho

ROSS DISTRIBUTING COMPANY
78 SOUTH STATE STREET
P.O. BOX 234
PRESTON, ID 83263
(208) 852-0830
M 9-2; T-F 9-6; S 9-2
Stock All Major Brands
Over 7000 Ham Related Items on Hand

Illinois

ERICKSON COMMUNICATIONS, INC.
5456 N. MILWAUKEE AVE.
CHICAGO, IL 60630
312-631-5181
Hours: 9:30-5:30 Mon, Tu, Wed & Fri; 9:30-8:00 Thurs; 9:00-3:00 Sat.

Indiana

THE HAM STATION
220 N. FULTON AVE.
EVANSVILLE, IN 47710
(800) 523-7731
(812) 422-0231
ICOM, Yeasu, Ten-Tec, Cushcraft, Hy-Gain, AEA & others.

Maryland

MARYLAND RADIO CENTER
8576 LAURELDALE DRIVE
LAUREL, MD 20707
301-725-1212
Kenwood, Ten-Tec, Kantronics. Full service dealer.
M-F 10-7 SAT 9-5

Massachusetts

TEL-COM, INC.
675 GREAT ROAD, RTE. 119
LITTLETON, MA 01460
617-486-3400
617-486-3040
The Ham Store of New England You Can Rely On.

Missouri

MISSOURI RADIO CENTER
102 NW BUSINESS PARK LANE
KANSAS CITY, MO 64150
(800) 821-7323
Missouri: (816) 741-8118
ICOM, Kenwood, Yaesu
Same day service, low prices.

Nevada

AMATEUR ELECTRONIC SUPPLY
1072 N. RANCHO DRIVE
LAS VEGAS, NV 89106
702-647-3114
Dale Porray "Squeak," AD7K
Outside Nev: 1 (800) 634-6227
Hours M-F 9-5:30, Sat. 9-3

New Hampshire

RIVENDELL ELECTRONICS
8 LONDONDERRY ROAD
DERRY, N. H. 03038
603-434-5371
Hours M-S 10-5; THURS 10-7
Closed Sun/Holidays

Dealers: YOU SHOULD BE HERE TOO!
Contact Ham Radio now for complete details.

New Jersey

ABARIS SYSTEMS
276 ORIENTAL PLACE
LYNDHURST, NJ 07071
201-939-0015
Don WB2GPU
ARRL, Astatic, Astron, B&W, Belden, Bencher, Hustler, Kenwood, Larsen, RF Concepts, Tonna and much, much more!
Tues-Fri 10 am-7:30 pm
Thurs 10 am-9:00 pm
Sat 10 am-4:00 pm
VISA/MC

KJI ELECTRONICS
66 SKYTOP ROAD
CEDAR GROVE, NJ 07009
(201) 239-4389
Gene K2KJI
Maryann K2RVH
Distributor of: KLM, Mirage, ICOM, Larsen, Lunar, Astron. Wholesale - retail.

New York

BARRY ELECTRONICS
512 BROADWAY
NEW YORK, NY 10012
212-925-7000
New York City's Largest Full Service Ham and Commercial Radio Store.

VHF COMMUNICATIONS
280 TIFFANY AVENUE
JAMESTOWN, NY 14701
716-664-6345
Call after 7 PM and save! Supplying all of your Amateur needs. Featuring ICOM "The World System." Western New York's finest Amateur dealer.

Ohio

AMATEUR ELECTRONIC SUPPLY
28940 EUCLID AVE.
WICKLIFFE, OH 44092 (Cleveland Area)
216-585-7388
Ohio Wats: 1 (800) 362-0290
Outside Ohio: 1 (800) 321-3594
Hours M-F 9-5:30, Sat. 9-3

DEBCO ELECTRONICS, INC.
3931 EDWARDS RD.
CINCINNATI, OHIO 45209
(513) 531-4499
Mon-Sat 10AM-9PM
Sun 12-6PM
We buy and sell all types of electronic parts.

UNIVERSAL AMATEUR RADIO, INC.
1280 AIDA DRIVE
REYNOLDSBURG (COLUMBUS), OH 43068
614-866-4267
Featuring Kenwood, Yaesu, Icom, and other fine gear. Factory authorized sales and service. Shortwave specialists. Near I-270 and airport.

Pennsylvania

HAMTRONICS, DIV. OF TREVOSE ELECTRONICS
4033 BROWNSVILLE ROAD
TREVOSE, PA 19047
215-357-1400
Same Location for over 30 Years

Texas

MADISON ELECTRONICS SUPPLY
3621 FANNIN
HOUSTON, TX 77004
713-520-7300
Christmas?? Now??

K COMM dba THE HAM STORE
5707A MOBUD
SAN ANTONIO, TX 78238
512-680-6110
800-344-3144
Stocking all major lines. San Antonio's Ham Store. Great Prices — Great Service. Factory authorized sales and service.
Hours: M-F 10-6; SAT 9-3

MISSION COMMUNICATIONS
11903 ALEIF CLODINE
SUITE 500 (CORNER HARWIN & KIRKWOOD)
HOUSTON, TEXAS 77082
(713) 879-7764
Now in Southwest Houston—full line of equipment. All the essentials and extras for the "ham."

Wisconsin

AMATEUR ELECTRONIC SUPPLY
4828 W. FOND DU LAC AVE.
MILWAUKEE, WI 53216
414-442-4200
Wisc. Wats: 1 (800) 242-5195
Outside Wisc: 1 (800) 558-0411
M-F 9-5:30 Sat 9-3

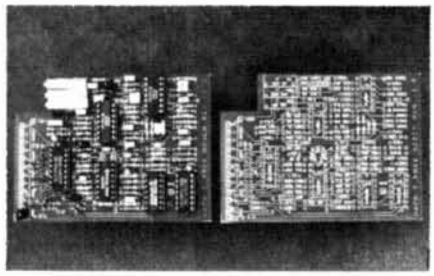
NEW products

The modem contains a multiplexer for switching between the 4800 HAPN-T and the 1200-baud modem on the TNC mother board. Detailed instructions are included for assembly and installation onto the TAPR TNC-1 and TNC-2 (and true clones, like MFJs).

The modem is available from HAPN in kit form. Write to: HAPN, Box 4466, Station D, Hamilton, Ontario, Canada, L8V4S7.

The cost of the bare board is $15 United States, $18 Canada. A parts kit containing the circuit board and components is $48 United States, $60 Canada. There is a 10-percent discount for orders of 5 or more units. Handling and shipping is $5 ($8 for overseas orders).

Circle #314 on Reader Service Card.



JANUARY WINNERS

Congratulations to Anthony Davis, N4SAS, our January sweeps winner and William Schreiber, NH6N, author of January's most popular WEEKENDER — "Going Digital." Both will receive a copy of *The Radio Handbook* by Bill Orr, W6SAI. To enter for February's drawing, send in the evaluation card bound into this issue, or submit a WEEKENDER project. You could be our next winner! *Ed.*

FLEA MARKET

RATES Noncommercial ads 10¢ per word; commercial ads 60¢ 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) on a space available basis only. Repeat insertions of hamfest ads pay the non-commercial rate.

COPY No special layout or arrangements available. Material should be typewritten or clearly printed (**not** all capitals) and must include full name and address. We reserve the right to reject unsuitable copy. **Ham Radio** cannot 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.

BEGINNER'S RADIO CLEARINGHOUSE. On a space available basis, we are going to offer you, OUR SUBSCRIBER, free of charge, a chance to find a home for your used equipment with a new Ham. Please send us a short description of what you want to sell along with price, name, address and phone number. We'll run it once in a special section of the classified ads under the heading of BEGINNER'S RADIO CLEARINGHOUSE. Please limit your ad to 20 words or less.

YAESU FT-101E TRANSCEIVER. CW filter, fan, mint, $360. New 1989 Callbooks (postpaid USA): N.A. $23.50, International $25.50. Duane Heise, AA6EE, 16832 Whirlwind, Ramona, CA 92065. (619) 789-3674.

NATIONAL Radio Manual and NCL-2000 factory parts lists. SASE. Max Fuchs, 11 Plymouth Lane, Swampscott, MA 01907.

ELECTRONIC KITS & ASSEMBLIES. For our latest catalog send SASE (45 cents) to: A & A ENGINEERING, 2521 W. LaPalma, #K, Anaheim, CA 92801.

IBM-PC SOFTWARE FOR PK-232. New CompRtty II/PK is the complete communications program for the PK-232/HK-232. Uses host mode of PK-232 for complete control. Text entry via built-in screen editor! Adjustable split screen display, including optional Triple Split ™ in Packet mode. Instant mode/speed change. Hardcopy, diskcopy, break-in buffer, select calling, text file transfer, customizable full screen logging, 24 programmable 1000 character messages, mailbox facility. Ideal for MARS and traffic handling. Requires 256k PC compatible. $65. Non-PK-232 version still available. Send call letters (including MARS) with order. David A. Rice, KC2HO, 144 N. Putt Corners Rd, New Paltz, NY 12561.

COMMODORE/AMIGA CHIPS (eg. 6510-$12.55, 6526-$13.50, 6567-$19.95, 6581-$14.85, 82S100-$15.75, 901 ROM Series-$12.50), PARTS, DIAGNOSTICS, HARD TO FIND ITEMS. Authorized service center. Fast REPAIRS, low cost (eg. C64-$49.95 plus UPS). Heavy duty power supplies for the C64-$27.95 plus UPS. Kasara Microsystems (Division of QEP), Route 9W/Kay Fries Drive, Stony Point, NY 10980, 1-800-248-2983 (outside NY) or 914-942-2252.

ANTENNA PARTS CATALOG, LOWEST COSTS: Dipole/Quad/Ground Radial wire, insulators, center feeds, open wire feed line, coax, relays, (#14 multistrand dipole/quad wire, non-stretch, very flexible, $34 per 275' (minimum), $.12/ft. thereafter, includes shipping). Catalog: $2.00. DAVIS RF, PO Box 230-H, Carlisle, MA 01741. (508) 369-1738.

UHF PARTS. GaAs Fets, mmics, chip caps, feedthrus, teflon pcb, high Q trimmers. Moonbounce quality preamps. Electronic sequencer boards. Send SASE for complete list or call (313) 753-4581 evenings. MICROWAVE COMPONENTS, PO Box 1697, Taylor, MI 48180.

COMMODORE-128 PROGRAM available to track the Amateur Satellites. Uses Keperlian data supplied by NASA free. Tracks up to 8 satellites simultaneously. Program also supports printing schedules and predictions for satellites. Use it to track MIR and talk to the Cosmonauts. SATRAK128, $26.50 includes shipping. Other information on this or other programs for the C128, requires a business size SASE. Reid Bristor, WA4UPD, PO Box 0773, Melbourne, Florida 32936-0773.

WANT: 32S3 xmtr, 250TL and 304TL tubes. KF6WM, 45300 Royal, King City, CA 93930.

WANTED: Heath SB-220/1 mint cond. Jim, WA8CAJ (702) 827-3074.

$50 PACKET Digicom 64—software based PACKET system for Commodore 64. Software is public domain and requires a modem for the C64 which is provided by our kit. Board plugs directly into cassette port or remote mounted via cable, both connectors included. Watchdog timer, reed relay PTT and PTT inversion options included. Power derived from computer. Uses 7910 chip—no alignment required. Switch allows HF or VHF operation. Order Kit #154 for $49.95 or Assembly #154 for $79.95 both include FREE DISK. Add $2.50 s/h. A & A ENGINEERING, 2521 W. LaPalma #K, Anaheim, CA 92801. (714) 952-2114. MC or VISA accepted.

OFFICIAL MILITARY-TYPE ID TAGS. ("Dog Tags")!! Customized with your Call Letters, etc. 5 seventeen space lines. 20" nickel plated chain included. $4.29 postpaid. JPW ENTERPRISES, PO Box 353, Logan, Utah 84321

MAGAZINES WANTED: "Microwave Systems News" (MSN), "RF Design", "PCIM (Power Conversion & Intelligent Motion)" and "QEX" (1980-present). Call collect 519-742-4594 (Ontario) after 6 PM Eastern time.

IMRA International Mission Radio Association helps missionaries. Equipment loaned. Weekday net, 14.280 MHz, 1-3 PM Eastern. Nine hundred Amateurs in 40 countries. Rev. Thomas Sable, S.J., University of Scranton, Scranton, PA 18510.

BACK ISSUES OF HAM RADIO. Have most issues from 1969 to 1974. Mint condition. $3.00 for single issues. WN0G, 319-377-3563.

FOR SALE: HW-101, TR-4, HT-37, 75A2, best offer. Want—Pair 8875 tubes. Tom Johnson, N6BP, 5060—500 Avenue West, Oak Harbor, WA 98277.

HAM TRADER YELLOW SHEETS. In our 27th year. Buy, swap, sell ham radio gear. Published twice a month. Ads quickly circulate—no long wait for results. Send No. 10 SASE for sample copy. $13 for one year (24 issues). PO Box 2057, Glen Ellyn, IL 60138-2057 or PO Box 15142, Dept HR, Seattle, WA 98115.

VHF-UHF-SHF. Large SASE. West Coast VHFer, POB 685, Holbrook, AZ 86025.

CHASSIS & CABINET KITS. SASE. K3IWK, 5120 Harmony Grove Rd, Dover, PA 17315.

ANALOG AND RF CONSULTING for the San Francisco Bay area. Commercial and military circuits and systems. James Long, Ph.D., N6YB (408) 733-8329.

RTTY JOURNAL—Now in our 36th year. Read about RTTY, AMTOR, PACKET, MSO'S, RTTY CONTESTING, RTTY DX and much more. Year's subscription to RTTY JOURNAL $10.00, foreign slightly higher. Order from: RTTY JOURNAL, 9085 La Casita Ave., Fountain Valley, CA 92708.

RUBBER STAMPS: 3 lines $5.00 PPD. Send check or MO to G.L. Pierce, 5521 Birkdale Way, San Diego, CA 92117. SASE brings information.

ELECTRON TUBES: Receiving, transmitting, microwave... all types available. Large stock. Next day delivery, most cases. DAILY ELECTRONICS, PO Box 5029, Compton, CA 90224. (213) 774-1255.

DIGITAL AUTOMATIC DISPLAYS. Any Radio. Be specific. GRAND SYSTEMS, POB 2171, Blaine, WA 98230.

"HAMLOG" COMPUTER PROGRAM. Full features, 17 modules. Auto-logs, 7-band WAS/DXCC. Apple $19.95. IBM, CP/M, KAYPRO, Tandy, C128 $24.95. HR-KA1AWH, POB 2015, Peabody, MA 01960.

EXPLORE the license free 160-190 kHz band. Communications over 100 miles have been achieved and our kits will help you get on the air fast! Send stamp for brochure to: SEDEN COMMUNICATIONS, 1272 Harold Avenue, Simi Valley, CA 93065

WANTED: ARC-5 and SCR-274 equipment, parts and accessories, any condition. Ken, WB9OZR, 362 Echo Valley, Kinnelon, NJ 07405. (201) 492-9319.

WANTED: Ham equipment and other property. The Radio Club of Junior High School 22 NYC, Inc. is a nonprofit organization, granted 501(C) (3) status by the IRS, incorporated with the goal of using the theme of Ham Radio to further and enhance the education of young people. Your property donation or financial support would be greatly appreciated and acknowledged with a receipt for your tax deductible contribution. We sponsor the classroom net on 7.238 at 1200 UTC daily and encourage your QSL for our weekly award. Please write us at: PO box 1052, New York, NY 10002 or call our round the clock hotline: (516) 674-4072. Thank you!

CUSTOM MADE EMBROIDERED PATCHES. Any size, shape, colors. Five patch minimum. Free sample, prices and ordering information. HEIN SPECIALTIES, Inc., Dept 301, 4202 N. Drake, Chicago, IL 60618.

WANTED: Drake Linear Amp Model MN4439- 1000W (2000 PEP), 1.8-30 MHz. Call Bruno Molino, VE2FLB, 26 Rue Des Anciens, Gatineau, Quebec J8T 3T2. (819) 561-3689.

RECONDITIONED TEST EQUIPMENT $1.25 for catalog. Walter, 2697 Nickel, San Pablo, CA 94806.

SCHOLARSHIP. The Dayton Amateur Radio Association is now accepting applications for its 1989 Scholarship Program. The program is open to any licensed Amateur graduating from high school in 1989. For information and application forms write Scholarship Committee, 317 Ernst Avenue, Dayton, OH 45405.

COMING EVENTS

Activities — "Places to go . . ."

SPECIAL REQUEST TO ALL AMATEUR RADIO PUBLICITY COORDINATORS: PLEASE INDICATE IN YOUR ANNOUNCEMENTS WHETHER OR NOT YOUR HAMFEST LOCATION, CLASSES, EXAMS, MEETINGS, FLEA MARKETS, ETC, ARE WHEELCHAIR ACCESSIBLE. THIS INFORMATION WOULD BE GREATLY APPRECIATED BY OUR BROTHER/SISTER HAMS WITH LIMITED PHYSICAL ABILITY.

NEW JERSEY: March 11. The Shore Points ARC's Springfest '89, Atlantic County 4-H Center, Rt 50, Egg Harbor City. Doors opn 9 AM. Sellers setup 7 AM. Admission buyers $3. Talk in on 146.385/.985 and 146.52. For information write SPARC, PO Box 142, Absecon, NJ 08201.

MICHIGAN: March 18. The 28th annual Michigan Crossroads Hamfest sponsored by the Michigan Amateur Radio Society and the Marshall High Photo Electronics Club, Marshall High School. 8 AM to 3 PM. Setup 6 AM. Tickets $3.00/door. $2/advance (SASE). Tables 50 cents/foot, minimum 4 ft. Reserved until 8 AM. SASE to SMARS, PO Box 934, Battle Creek, MI 49016 or call Wes Chaney, N8BDM (616) 979-3433.

NORTH CAROLINA: March 18-19. The Mecklenburg Amateur Radio Society is sponsoring the Charlotte Hamfest and Computerfair, ARRL Roanoke Division Convention, Charlotte Convention Center, 4th and College Streets, uptown Charlotte. Saturday 9-5, Sunday 9-2. Tickets $5/advance; $7/door. Children under 12 free. Flea market tables $12 advance only. Tickets and tables good for both days. Programs, forums, license exams, nearby parking and restaurants. For reservations and information write Charlotte Hamfest, PO Box 221136, Charlotte, NC 28222-1136.

TEXAS: March 18. The Midland ARC will hold its annual St. Patrick's Day Swapfest, Midland County Exhibit Building, east of Midland on north side of Hwy 80. 8 AM to 2:30 PM. Pre-registration $5, $6 at the door. Tables $6. each. License exams. For information and reservations Midland Amateur Radio Club, PO Box 4401, Midland, TX 79704.

ILLINOIS: March 19. The Libertyville and Mundelein Amateur Radio Society (LAMARS) will hold its annual LAMARSFEST 1989 at the Lake County Fairgrounds Rts 120 and 45. Large indoor electronic and radio swapfest, exhibitors, rest area, free parking, public cafeteria. Admission $2/advance; $3/door. Swap tables $5. Commercial tables $20 by reservation only. Doors open 8 AM. Setup 6 AM. Talk in on 147.63/03 Waukegan repeater and 146.52. For information write LAMARS, PO Box 751, Libertyville, IL 60048 of call Bob Dick, NY9E (312) 362-9634 after 7 PM.

OHIO: March 19. The Toledo Mobile Radio Assn's Hamfest, Lucas County Recreation Center, Key Street, Maumee. 8 AM to 5 PM. Admisison $3.50/advance; $4/door. Talk in on 147.27 repeater or 442.85 repeater. Contact: Ron Morris, WB8ZIM, 28141 Glenwood Rd, Perrysburg, OH 43551. (419) 666-8063.

KENTUCKY: March 25. Kentucky State ARRL Convention sponsored by the Lincoln Trail ARC, Pritchard Community Center, Elizabethtown. Admission $4/advance; $5/door. For advance tickets, setup reservations and exam info contact Chuck Strain, AA4ZD, PO Box 342, Vine Grove, KY 40175. (502) 351-1715.

MISSOURI: March 31-April 2. The PHD ARA will sponsor the 1989 Midwest ARRL Convention, Kansas City Convention Center, 13 and Broadway. Exhibits 9-5 Saturday and Sunday. Setups

3-8 PM Friday. DX, QCWA, Packet, Computers, ATV, ARRL, FCC and more. Exams 8 AM Sunday. No walkins. Large indoor flea market tables $10. Pre-registration $5. $7 at the door. Saturday evening banquet $13.50. All pre-registrations must be postmarked by March 20, 1989. Mail to PHD ARA, PO Box 11, Liberty, MO 64068. Phone (816) 781-7313. SASE for confirmation or information.

NEW JERSEY: April 8. Ham Radio flea Market sponsored by the Chestnut Ridge Radio Club, Education Building, Saddle River Reformed Church, East Saddle River Road and Weiss Road, Upper Saddle River. Tables $10 for first, $5 each additional. Tailgating $5. Admission $1. Contact Jack Meagher, W2EHD (201) 768-8360.

INDIANA: April 8. The Columbus Amateur Radio Club Hamfest. Bartholomew County 4-H Fairgrounds, State Road 11, Columbus. 8 AM to 2 PM. Talk in on 146.79 -600 Hz. For information David Mann, KA9UUP, 458N Country Club Road, Columbus, IN 47201. (812) 342-6302.

WISCONSIN: April 9. The Madison Area Repeater Association (MARA) is having its 17th annual Madison Swapfest, Dane County Exposition Center Forum Building, Madison. Doors open 7 AM for flea market sellers and 8AM for general public. Admission $3 advance, $4/door. Under age 12 admitted free. Flea market tables $8 advance; $9/door plus admission. Advance reservations by March 31, 1989. Talk in on MARA repeater WE9AER/R, 147.75/.15. For tables or info on commercial space write MARA, PO Box 4007, Madison, WI 53711 (608) 274-5153 day or night.

MASSACHUSETTS: April 9. The Framingham Amateur Radio Assn will hold its annual Spring Flea Market and License exams, Framingham Civic League Building, 214 Concord Street (Rt 126) in downtown Framingham. EARLY BIRD BUYERS doors open at 9 AM. Admission $5.00. ALL OTHER BUYERS doors open 10 AM. Admission $2.00. Tables $12, setup time 8:30 AM. Pre-registration for flea market and exams is required. Talk in on 147.75/15 Framingham Repeater. For information and table reservations contact Jon Weiner, K1VVC, 52 Overlook Drive, Framingham, MA 01701. (508) 877-7166. For license exams send Form 610, copy of license and $4.65 check payable to ARRL/VEC, Framingham ARA, PO Box 3005, Framingham, MA 01701.

NEW JERSEY: April 15. "Flemington Hamfest 89", sponsored by the Cherryville Repeater Association, 8 AM in the Hunterdon Central High School Field House. Admission: $4 advance, $5 door. Children under 12 and XYLs free. Refreshments available from 6:30 AM. Advance tickets: Dave Hickson, KD2RC, 125 South Main St, Lambertville, NJ 08530. Tables: Marty Grozinski, NS2K, 6 Kirkbridge Rd, Flemington, NJ 08822. Information: (201) 788-4080 before 11 PM EST. VE testing begins at 10 AM, send FCC form 610, photocopy of current license, and a check for $4.75 (payable ARRL/VEC) to: Cherryville Repeater Association, VE Test Team, Box 308, Quakertown, NJ 08868. Talk in: 146.52, 147.975/375, 145.615/015, 222.52/224.12 and 449.85/444.85 MHz.

ILLINOIS: April 16. The Moultrie Amateur Radio Klub's 26th annual Hamfest, Moultrie County 4-H Grounds, Cadwell Road, 4 miles east of Sullivan. Gates open 7 AM. Tickets $3; 2/$5. Large covered outdoor area available FCFS. No charge for vendors. Food available. For information Ralph Zancha, WC9V (217) 873-5287 or write MARK, PO Box 79, Sullivan, IL 61911.

DAYTON HAMVENTION: April 28, 29, 30.

OHIO: April 28. The 4th annual DX Dinner, Dayton Hamvention Weekend, sponsored by the SouthWest Ohio DX Association, Stouffer's Dayton Plaza Hotel. Cash bar 6:30 PM; dinner at 7 PM. Keynote speaker Dave Heil, J52US. Master of Ceremonies Frank Schwab, W8OK. Banquet $22.00 per person by reservation only. Please SASE along with check or MO payable to SWODXA to Scott Lehman, N9AG, PO Box 803, Greenville, OH 45331.

OHIO: April 29. The 20th annual B*A*S*H will be held on Friday night of the Hamvention at the Conference Center (Madison Room) of the HARA Arena and Conference Center, same location as the Hamvention, starting at 7 PM. No admission charge. Free continuous entertainment. Hot dinner, sandwiches, snacks and beverages are available. Two exciting top awards and many others. Stay right at HARA when the Hamvention closes on Friday evening and meet your friends and join us for an evening of fun and entertainment. Sponsored by the Miami Valley FM Association, PO Box 263, Dayton, Ohio 45401.

OPERATING EVENTS

"Things to do . . ."

The DeVry Amateur Radio Society has been a national VEC since February 23, 1984. We have over 40 testing groups nationwide and are continuing to grow. We offer a program based upon integrity and creativity. The forms our VE's are required to fill out are simple and to the point. We also reimburse all our testing groups for out-of-pocket expenses. If you would like to start a DeVry VE team in your area just call 1-800-327-2444, ext 2221 or 1-312-929-8500 or write DeVry VEC, 3300 N. Campbell Avenue, Chicago, IL 60618.

NORTH COAST ARC 1989 LICENSE EXAMS. 12:30 PM, Saturdays February 11, April 15, June 10, August 12, October 14, December 9. N. Olmsted Community Cabin, S of Lorain on W. Park. Novice thru Extra. Walkins allowed. Talk in 145.29 repeater. For information Dan Sarama, KB8A, 15591 Rademaker Blvd, Brookpark, Ohio 44142. 267-5083 or Pauline Wells, KA8FOE, Rick Wells, K8SCI, 777-9460/779-8999.

AMATEUR RADIO CLASSES: For those people interested in obtaining a Novice (basic level) Ham license or upgrading to Tech/General, the Chelsea Civil Defense, in cooperation with QRA Radio Club, will sponsor Amateur Radio Communications classes evenings at Chelsea High School starting MARCH 7, 1989. For more information write Frank Masucci, K1BPN, 136 Grove Street, Chelsea, MA 02150. Please enclose your telephone number.

THE MIT UHF REPEATER ASSOCIATION and the MIT Radio Society offer monthly HAM EXAMS. All classes Novice to Extra. Wednesday, MARCH 22, 7 PM, MIT Room 1-150, 77 Mass Avenue, Cambridge, MA. Reservations requested 2 days in advance. Contact Ron Hoffmann at (617) 484-2098. Exam fee $4.50. Bring a copy of your current license (if any), two forms of picture ID, and a completed form 610 available from the FCC in Quincy, MA (617) 770-4023.

MOVING?

KEEP HAM RADIO COMING . . .

If possible let us know four to six weeks before you move and we will make sure your HAM RADIO Magazine arrives on schedule. Just remove the mailing label from this magazine and affix below. Then complete your new address (or any other corrections) in the space provided and we'll take care of the rest.

ham radio Magazine
Greenville, NH 03048

Allow 4-6 weeks for correction.

Thanks for helping us to serve you better.

Here's my new address:

Name ______ Call ______
Address ______
City ______ State ______ Zip ______

AFFIX LABEL HERE

Foreign Subscription Agents for Ham Radio Magazine

Ham Radio Austria Karin Ueber Postfach 2454 D-7850 Loerrach West Germany	Canada Send orders to Ham Radio Magazine Greenville, NH 03048 USA Prices in Canadian funds 1 yr. $41.85, 2 yrs. $74.25 3 yrs. $99.90
Ham Radio Belgium Stereohouse Brusselsesteenweg 416 B-9218 Gent Belgium	Ham Radio Italy Via Maniago 15 I-20134 Milano Italy
Ham Radio Holland Postbus 413 NL-7800 Ar Emmen Holland	Ham Radio Japan Katsumi Electronic Co., Ltd 27-5 Ikeyami 4 Chome, Ota Ku Tokyo 146, Japan Telephone (03) 753-2405
Ham Radio Europe Box 2084 S-194 02 Upplands Vasby Sweden	Ham Radio Switzerland Karin Ueber Postfach 2454 D-7850 Loerrach West Germany
Ham Radio France SM Electronic 20 bis, Ave des Clarions F-89000 Auxerre France	Ham Radio England c/o R.S.G.B. Lambda House Cranborne Road Potters Bar Herts EN6 3JW England
Ham Radio Germany Karin Ueber Postfach 2454 D-7850 Loerrach West Germany	Holland Radio 143 Greenway Greenside, Johannesburg Republic of South Africa

CORRECTION

ILLINOIS: March 12. The Sterling-Rock Falls ARS 29th annual Hamfest, Sterling High School Field House, 1608 Fourth Avenue, Sterling. Doors open 7:30 AM. Tickets $3/advance; $4/door. Dealers, large flea market, VE exams. Talk in on 146.25/146.85 W9MEP Repeater. For information, tables or tickets contact Sue Peters, P.O. Box 521, Sterling, IL 61081 or call AC (815) 625-9262.

ELMER's NOTEBOOK

Tom McMullen, W1SL

Packet radio for the first-timer

I came up with the subject for this month's column after overhearing comments and conversations at some recent hamfests. It was apparent that quite a few Amateurs would like to explore packet (and other digital modes), but are a bit puzzled about what to do after buying the equipment and plugging it in. After all, it's slightly more complex than getting started with a CW rig where you hook all the pieces together, tap out a CQ on the key, and listen for a reply. A first-time venture into the phone bands is not all that difficult either. A "hello" into a microphone will often bring back a surprising "hello yourself" from the receiver, or perhaps a "QRZed?" Once you get to this point, establishing a QSO isn't hard at all.

Many people are easily intimidated by computers, and connecting one to a transceiver can make "mike fright" or a "frozen fist" seem insignificant. The first step is to get on good terms with your computer. No matter what make it is, learn to use the built-in features: how to save files to a hard drive or a floppy diskette, what to do when it says "syntax error," and how to recover from the inevitable "dead-keyboard" experience — when the little cursor just blinks at you or, even more unsettling, the screen stays blank! But these procedures are more properly addressed in the realm of an article or book on computer operations, and this column is about Amateur Radio, so let's direct our attention to making the packet radio system do its thing.

For almost all packet systems, you need a "communications" or "terminal" program for your computer. Many of the common ones available will work — I've used QModem, PC-Talk, Bitcomm, PC-Pakratt, and Power-comm 12 on my PC/AT. My favorite is Procomm because it's the one I've used the most for checking into bulletin boards and data services via the telephone line and a modem. Use whatever program you're comfortable with; the goal is to have your computer talk to the outside world.

The next step is to establish communications with your packet equipment, the Terminal Node Controller (TNC). This is the interface between your computer and the radio equipment. It contains all the "smarts" to accept what you type on the keyboard and turn it into a message complete with headers, addresses, error-checking methods, etc. It also works in the reverse — deciphering a received packet of information and turning it into words to display on your screen.

There are many variations of the commands used in packet systems and it would be impossible to describe all of them here. Look at the instruction manual for your particular TNC and make a list of the commands you're most likely to use at the beginning, based on those described here.

The TNC I now use is the PK-232 by AEA. I used to have a TNC-1 from the Tucson Amateur Packet Radio Corporation (TAPR). TAPR has come out with a TNC-2, but I haven't tried it. Some commands are the same for the PK-232 and the TNC-1; some are not. The PK-232 has a very large set of commands covering everything from calibrating the system to switching from VHF to HF or from packet to AMTOR or RTTY. You'll need only eight or ten commands to start having fun on this mode.

Your first words

The first thing that you should see when your computer and the TNC start talking to each other is a message of some sort. It will probably give you a copyright notice, the date the program was released, and perhaps some other information as well. The greeting should be followed by the letters **cmd:** (a prompt, asking you for a command or instructions).

Before going further, you need to know that the TNC has two modes of operation — the command mode where it's waiting for instructions and where it responds to those instructions, and the converse mode where it will interact with another station by receiving and sending packets. When you see the **cmd:** (or **CMD:**) prompt, the TNC expects some instructions from you. Please note: most TNCs don't care whether you use upper or lower case. I'll use lower case for our purposes.

If you haven't already done so, now is the time to tell the TNC who you are. You do this by typing **mycall** or just **my** and then hitting the return or enter key, whichever you have. (Some keyboards have a symbol like a backwards letter L with an arrowhead. They all do the same thing.)

Most TNCs will accept either the

entire command or a one- or two-letter abbreviation. The monitor will show a statement, like **mycall aaa**, in answer to what you just typed. You can then respond with **mycall** (type your call here) and return. Your call is now stored in memory and will be used whenever a packet is sent or received. The call stays in memory even when the equipment is turned off, so you don't need to repeat this step the next time you use it.

The command mode

In addition to letting you give instructions, the command mode will let you find out all kinds of things about your terminal. Just type **display** (or **disp**) followed by a letter or number at the **cmd:** prompt. For example, **cmd:disp L** will fill your screen with the link status information. You won't use much of it for most operation, but it's there when you want it. At the moment, the statement you're looking for is that link status is disconnected (meaning that you are not connected to another station).

Another useful display is the monitor parameters. Here you can see what the monitor function is doing. (This is the monitor activity of your terminal, *not* the video-display screen you are looking at.) Typing **comd:disp m** will give you a screen full of monitor settings. Among these the **mfrom** setting is important because it determines what on-air activity you'll see on your screen. Three other commands very useful for a beginner are: **help**, **connect**, and **disconnect**.

Here's an important tip: If things get so confused that you're not sure what's going on, and you don't see the **cmd:** prompt, you can always get back to the prompt by holding down the control key and the C key at the same time (sometimes written in text as <control-C> or <^C>. This puts the system back in the command mode, and you can start over.

Try the **help** command **(cmd:help)** just to get familiar with what's available. After you've made a few dozen contacts you'll know all about the system anyway, but for now it's nice to know that it can help you out. It's reassuring to know that most terminals will let you know when they don't understand something. For instance, if I type **connet** when I mean **connect**, the system replies with **?what?**

After you've entered your call into the machinery and looked at the help screen for reassurance, try monitoring some activity. Make sure your transceiver is tuned to a packet frequency, and that there's something going on. You'll have to tell the terminal what you want to monitor. On some TNCs, you do this by typing **monitor all**, **monall**, **mall**, or **mall on**. For the PK-232, the command is **mfrom**. If you just type **mfrom**, the TNC will tell you its current setting; if it says **mfrom none** you won't see any activity. Type **mfrom all** and you'll see what's happening — including packets between two stations, packets being relayed, or announcements (beacons) from local bulletin-board stations. Later on, you can become more selective and give your TNC a list of the calls you want to monitor by typing **mfrom yes**. (List the calls, separated by a comma.) You can also shut out calls by typing **mfrom no** (call or calls).

The connection

After you've monitored the activity for a while, try a contact. Note the call of someone who has just disconnected (or sent a CQ packet), and type in **connect** (type in his call) and hit return. You could try this with a bulletin board, but if you do, be prepared for a screen full of announcements and/or questions about who you are and whether you'd like to sign up as a member, etc. If the station you picked is available, your screen should show **connected to** (his call). At this point, almost all TNCs go into the converse mode automatically. This means you can carry on a two-way QSO with the station you're connected to. Just type away — ask questions, talk about the weather, your rig, the family, or whatever.

Remember that what you type isn't sent to the other guy until you do a return. The return key is the computer's way of saying "over" on voice, or sending "K" on CW. (Standard practice on packet is to send three > > > symbols at the end of your last line of text to indicate "over".) You'll also see what the other station sends, but be patient. Some people are not high-speed typists, and typing two or three lines one-finger style can take a couple of minutes.

Via who?

You'll see some activity that has "via" or "v" in the list of callsigns, as in **connect WW4HAO via WW4DA**. This means they are connected through a digipeater. Some stations append a number after their call to help identify them as a digipeater, like WW4DA-2. Type in the station you want to connect with, the word **via** (or the letter **v** if your program can use that abbreviation), then the call of the digipeater (including the number, if any) and hit return. Once you've established a connection, you don't need to tell the terminal to use the digipeater each time — it will remember to do so until you end the contact.

Ending the contact? Just typing "bye" or "73" or "see-ya-later" won't hack it. That will tell the other guy you're all through, but you also have to tell your terminal. It's easy to do. Just type **disconnect**, **disc**, or simply **D** at the **cmd:** prompt. (You get back to **cmd:** by using control-C.) Your terminal will respond with **disconnected**. If the other station decides to quit first, and sends the disconnect command, your terminal will tell you that he has disconnected.

Another useful feature is the list of stations heard. It lets you get a feel for the activity in your area. On the PK-232 the command for this is **mheard**. The terminal will list the last 18 calls heard, and those heard directly (not through a repeater) will be marked with an asterisk (*). You can find out the times stations were on by typing **daystamp on** when you start up your station. The list will then include the time and date of each call shown.

Confusion factors

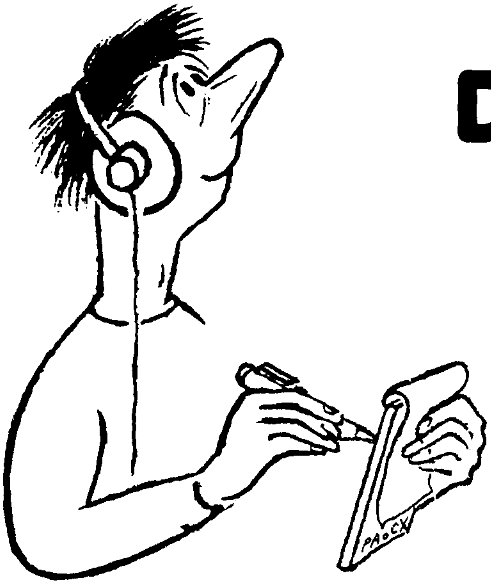
There are many things about this new mode that can leave a newcomer bewildered, wondering what went wrong and why. One is the lack of response when a **connect** request doesn't produce any results. Overlooking the possibility that the other station just shut down or told his terminal to ignore any more connect requests for the evening, a lack of response could be caused by collisions between packets (two stations trying to send at the same time). This doesn't happen often, but probably will as channels become more crowded. One thing you can do is find out the number of times your station will try before it gives up. Check the setting by typing **retry** at the **cmd:** prompt. The terminal should reply with a number, e.g., **retry 10**. You can change this by typing **retry** followed by any number from 0 to 15. **Retry 15** means your station will try 15 times before giving up and showing the message **retry count exceeded**. You can also change the amount of time between retries. The PK-232 does this by using the **frack** (frame acknowledge) command. For local stations, a low number like 2 or 3 seconds should be okay **(frack 3)**. If you're working through one or more digipeaters, use a larger number to allow time for the packet to be handled by the relay stations. You can specify a number up to 15 seconds, but it should be a compromise between how long you are willing to wait and what produces the most success in your area.

The timing between sending and receiving is a critical part of packet operation. Your TNC is capable of switching from transmit to receive in a few milliseconds, but your RF transceiver is not. Obviously, if the other station acknowledges the packet before your receiver is ready, you'll never make a contact, and vice versa. Modern diode-switched send/receive circuits are pretty good, but still require considerable switching time. Most transceivers that use relays for send/receive switching will require longer delays than solid-state equipment. This delay can be set from the **cmd:** prompt. The time is usually given in milliseconds — e.g., 500 = 500 milliseconds or 0.5 seconds. Start with some value around 600 mS (**cmd:dwait 600** for the PK-232), and try to connect to a local station. You can then lower the number to find a value that works well with your station.

Packet radio is a well-established, growing communications mode. There are linking and network developments on the way that will be very exciting to explore. So dive in — don't let keyboard fright deprive you of a lot of very enjoyable QSOs.

Article L **HAM RADIO**

✓ 128



DX FORECASTER

Garth Stonehocker, KØRYW

Equinox DX conditions

March and April, the months of the spring equinox, show rapidly changing DX propagation conditions. One change is the increase in daylight hours. Also during these months geophysically unstable day-to-day phenomena are very noticeable. Weather storms come and go quickly across our skies, and you'll have nights and/or days of poor radio propagation conditions. Because DX propagation is so variable, you might try keeping up with these changes scientifically, or forecasting the DX conditions for a few hours or days. One forecasting system is based on two geophysical daily indices that are useful for predicting trends. These indices are the solar flux daily index and geomagnetic field disturbances.

The solar flux daily index is a measure of the radiated solar energy coming to earth. It's used to determine the electron density of the ionosphere during these rapidly changing months. There's about a 5-percent change between summer and winter (winter is the maximum). This year the 22nd sunspot cycle is the largest change affecting the solar flux. But remember the most rapid time of seasonal change (5 percent) is during the equinox months. The range of maximum usable frequencies in the E and F regions and signal absorption in the D region vary directly with the sun's radiation, as measured by the solar flux.

Rapid solar flux changes aren't the only cause of unstable propagation conditions in the mid- to high latitudes. Geomagnetic field disturbances also cause variable propagation conditions. These disturbances to the basic trend of the solar flux are short lived; they average two days if flare induced, and a day or two longer if due to coronal thinness. Either way, they are caused by particles flowing from the sun as solar wind. The wind enters the earth's atmosphere in the polar regions — around 80 degrees on the sunward side. As the particles enter the D and E regions, they decrease the signal strength and cause flutter, fading, and even total signal disappearance. Later during the night at lower latitudes (sometimes down to around 60 degrees) the F region becomes depleted, lowering the MUF there.

Both of these indices (geomagnetic and flux) are broadcast from radio frequency and time station WWV at 18 minutes after each hour. By keeping track of the daily values and noting the trend, you can forecast by extrapolation the continued direction of DX propagation conditions — both signal strength and MUFs. Increased solar flux means an immediate signal strength decrease, but within a day or two there will be increased MUFs with the potential for higher signals. For DX, increased geomagnetic A or K means decreased and variable signal strength and MUFs. On paths near the equator the MUFs rise with an increasing A index. You can try this forecasting method for your favorite DX path, or for DX conditions in general.

Last-minute forecast

March propagation conditions should mirror February's, as the 27-day solar rotation cycle is the most influential predictor available in this part of the 11-year sunspot cycle and it coincides with February's 28-day length. Expect the first 10 days of the month to favor the higher frequency bands with high MUFs and signal absorption from a solar flux maximum. Long skip with some chance for transequatorial openings should be available to southern countries. The lower bands will be most favorable for nighttime openings to northern and east-west countries from the 16th to the 24th. The solar flux is expected to climb after this date. Disturbed conditions may affect the bands near March 2nd, 10th, 19th, and 29th.

No regular meteor showers occur in March. The full moon is on the 22rd and its perigee is on the 8th. The vernal equinox is on March 20st at 1539 UTC. A partial (0.83 percent) solar eclipse is expected on the 7th from 1617 to 1958 UTC. It will be visible in Hawaii, the United States, Canada, and Greenland.

Band-by-band summary

Ten meters will be open to the south and southeast for an hour before local noon, to the south at noon, and to the southwest in the afternoon. The openings will be longer when the solar flux is at its 27-day cycle maximum. Transequatorial openings will also be best at that time.

Fifteen, 17, and 20 meters, almost always open to some part of the world, will be the main daytime DX bands. Twenty should stay open on long southern paths into the night, while 15 will drop out in the late afternoon. DX is 5000 to 7000 miles (8000-11200 km)

MARCH

WESTERN USA

	GMT	2300	2200	2100	2000	1900	1800	1700	1600	1500	1400	1300	1200	1100	1000	0900	0800	0700	0600	0500	0400	0300	0200	0100	0000
MARCH	PST	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00	6:00	5:00	4:00	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00	6:00	5:00	4:00
ASIA FAR EAST	N	20	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	20	20	15	15*	15*	15
EUROPE	NE	30	30	20	20	15	15	12	12	12	15	15	20	30	30	30	30	30	30	30	30	30	30	30	30
S. AFRICA	E	15	12	12	12	10	10	10	10	10	10	12	15	20	20	20	20	20	20	20	20	20	15	15	15
S. AMERICA	SE	10	10	10	10	10	10	10	12	12	15	15	20	20	20	20	20	20	15	15	12	12	12	10	10
ANTARCTICA	S	10	10	10	10	12	12	12	15	15	30	30	30	20	20	20	20	20	15	15	12	12	12	10	10
NEW ZEALAND	SW	10	10	10	12	12	12	15	15	20	20	20	20	20	20	20	15	15	15	12	12	10	10	10	10
OCEANIA AUSTRALIA	W	12	12	12	15	15	20	20	20	15	20	20	20	20	15	15	15	12	12	12	10	10	10	10	10
JAPAN	NW	12*	12	15	15	20	30	30	30	30	30	30	30	30	30	30	30	30	20	20	15	15	12	12	12*

MID USA

	MST	4:00	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00	6:00	5:00	4:00	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00	6:00	5:00
ASIA FAR EAST	N	30	30	30	30	30	30	30	30	20	15	15*	20	20	30	30	30	30	30	30	30	30	20	15	20
EUROPE	NE	30	30	20	20	15	15	12	12	15	15	20	20	20	30	30	30	30	30	30	30	30	30	30	30
S. AFRICA	E	15	12	12	12	10	10	10	10	10	10	10	12	12	15	20	20	20	20	20	20	20	15	15	15
S. AMERICA	SE	10	10	10	10	10	10	12	12	12	15	15	20	20	20	20	20	20	15	15	12	12	12	10	10
ANTARCTICA	S	10	10	10	12	12	12	15	15	15	15	30	20	20	20	20	20	20	15	15	12	12	12	10	10
NEW ZEALAND	SW	10	10	10	12	12	15	15	20	20	20	20	20	20	20	20	20	15	15	15	12	12	10	10	10
OCEANIA AUSTRALIA	W	10	12	12	15	15	15	20	20	15	15	20	20	20	20	20	15	15	15	15	12	10	10	10	10
JAPAN	NW	12	12	15	15	20	30	30	30	30	30	30	30	30	30	30	30	30	20	20	20	15	15	12	12
	CST	5:00	4:00	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00	6:00	5:00	4:00	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00	6:00

EASTERN USA

	EST	6:00	5:00	4:00	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00	6:00	5:00	4:00	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00
ASIA FAR EAST	N	30	30	30	30	30	30	30	30	30	20	20	15	15	15*	20	30	30	30	30	30	30	30	30	20
EUROPE	NE	30	30	20	20	15	15	15	15	15	15	20	20	20	20	30	30	30	30	30	30	30	30	30	30
S. AFRICA	E	15	12	12	10	10	10	10	10	10	10	10	10	12	12	20	20	20	20	20	20	20	15	15	15
CARIBBEAN S. AMERICA	SE	10	10	10	10	10	10	10	12	12	12	15	15	20	20	20	20	20	15	15	15	12	12	12	10
ANTARCTICA	S	10	10	10	12	12	12	12	15	15	15	15	20	20	20	20	20	20	15	15	12	12	12	10	10
NEW ZEALAND	SW	10	10	10	12	12	15	15	20	20	20	20	20	20	20	20	20	20	20	20	20	15	15	12	10
OCEANIA AUSTRALIA	W	10	10	12	12	15	20	20	20	15	15	15	15	20	20	20	20	20	15	15	15	12	10	10	10
JAPAN	NW	12	12	12	15	20	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	20	20	15

The italicized numbers signify the bands to try during the transition and early morning hours, while the standard type provides MUF during "normal" hours.

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

on these bands and one-long-hop transequatorial propagation is also possible, as on 10 meters.

Thirty and 40 meters are both day and night bands. Intermediate distances (1000-1500 miles, 1500-2200 km) in any direction represent daytime DX. Nighttime DX on these bands may be expected to offer a greater distance than on 80 meters and, like 80, to follow the darkness path across the sky. Reduced midday signal strengths and distances may occur on days of high solar flux values.

Eighty and 160 meters will exhibit short-skip conditions during daylight hours and lengthen for DX at dusk. These bands follow the darkness path, opening to the east just before local sunset, swinging more to the south near midnight, and ending up in the Pacific areas shortly before dawn. The 160-meter band opens later and ends earlier.

Article M **HAM RADIO**

LOW BAND DX-ING COMPUTER PROGRAMS

by John Devoldere, ON4UN, for Apple IIe/c, MS-DOS, Commodore C-128 Apple Macintosh and Kaypro CPM Computers

Here's a collection of 30 super programs written by ON4UN. Just about every interest or need is covered—from antenna design and optimization to general operating programs. Antenna programs include: shunt and series input L network design, feedline transformer, shunt network design, SWR calculation, plus 11 more! General Ham programs include: sunrise/sunset, great circle distances, grayline, vertical antenna design program, sunrise calendar plus 9 more! Phew. When you sit down to use these programs you'll be amazed at what you have. The best value in computer software available today. © 1986.

☐ **UN-Apple IIe/IIc**	**$39.95 ea.**
☐ **UN-MS (MS-DOS)**	**$39.95 ea.**
☐ **UN-CPM/Kaypro**	**$39.95 ea.**
☐ **UN-C-128 (COMMODORE)**	**$39.95 ea.**
☐ **UN-MAC (MACINTOSH)**	**$49.95**

LOW BAND DX'ING

by John Devoldere ON4UN

Now Available! The new, 2nd edition of the definitive book on Low Band DX'ing. Based upon years of practical on-the-air experience, learn the secrets of how ON4UN has been so successful on the low bands. Extensive coverage is given to transmit and receive antennas with clear concise explanations and plenty of illustrations—dipoles, inverted V's, slopers, phased arrays and Beverages—they're all in this book. Also covered: propagation, transmitters, receivers, operating, software and an extensive Low Band bibliography. Going to be a best seller! Get yours today. © 1987 2nd Edition 200 pages

☐ **AR-UN** **Softbound $9.95**

BUY'EM BOTH SPECIAL OFFER

Book & Software Reg. $49.90 ($59.90 for Mac)

Just $44.90 ($54.90 for Mac)

☐ **UN-SO (specify computer)**	**$44.90**
☐ **UN-MSO Macintosh Special**	**$54.90**

SAVE $5

Please enclose $3.50 shipping & handling

HAM RADIO BOOKSTORE

GREENVILLE, NH 03048 603-878-1441

Wideband Preamp 10-1000 Mhz

Dual GasFet low noise preamplifier for HF, UHF or VHF systems. Just perfect for the R-7000. Excellent for Spec Analyzers, Scanners, etc. Gain 20 Db +/- 1 DB, -3 Db at 2 & 1100 Mhz. 1 Db compression of >10 Dbm. Intercept points >45 Dbm. New shipped price of only $124.95. Pa. residents please add 6% state tax.

GTI Electronics
RD 1 BOX 272 ✓ 195
Lehighton, Pa. 18235
717-386-4032

LOGWRITE™

Bring your station into the computer age with **LOGWRITE**, the menu driven, user friendly logging program written by Ed Troy (NG3V). **LOGWRITE** is the perfect accessory for the complete ham station. It simplifies your operation and gives you the competitive edge in contesting and DX'ing. **LOGWRITE** works with all IBM PC's and compatibles.

LOGWRITE's unique split screen feature allows for simultaneous logging and text processing. Logging features include:

- Instant call sign or prefix search
- Print, Edit, or View records
- Plenty of room for notes & addresses
- Automatic time/date stamping

Text processor features automatic word wrap, backspace correct, and scrolling. Throw away your pen and paper!

To order your copy of **LOGWRITE**, complete with instruction manual, send $24.95 (Pa. residents add $1.50 sales tax) to:

Aerospace Consulting
P.O. Box 536, Buckingham, PA 18912
(215) 345-7184

Or call 1-(800) 345-4156 ext. 54 to order with Visa/Master Card. (Please specify 3.5 or 5.25 inch floppy.) ✓ 104

ANTENNA MODELING

Easy to use, with menus, and optional mouse. Enter parameters, and get a color coded sinusoidal projection of a MW or SW antenna. Move over the projection with a mouse or cursor and read the gain at that point. ***LONG WIRE PRO*** models long wires, vee's, dipoles, and rhombics displaying a sinusoidal projection. $40 ***VERTICAL PRO*** models single verticals or arrays displaying a sinusoidal projection, a ground wave plot, and the impedance of each element. $80

IBM PC compatible, DOS 2.0 or higher, 256K, CGA or EGA color required. International orders add $5 shipping.

EPSILON CO ✓ 129

Box 715, Trumbull CT, 06611, (203) 261-7694

MADISON SHOPPER

CALL FOR ORDERS
1 (800) 231-3057
1-713-520-7300 OR 1-713-520-0550
TEXAS ORDERS CALL COLLECT
FAX 1-713-771-7759
ALL ITEMS ARE GUARANTEED OR SALES PRICE REFUNDED

New Icom IC 781	Trades wanted
Kenwood TH215A, TH25AT	Trade in your old HT
TS440 S/AT	Call

Kenwood TS 140S	Call for trade
New Kenwood TM 721A, mobile	Call
ICOM 228H/TTM	449.00

TS 790A Superior 2 Meter 70 cm Rig.	
1.2 GHz Option Available	Call
Icom 761	2250.00
ICOM External relay box	
Specify Radio and Amp	Call
HEIL BM10 Boom Mike, wired 8 pin	69.00
HEIL HM5 Desk Mike	62.00
NYE MB5A Tuner	569.00
Alpha Delta Transitrap HV	33.00
CSI Private Patch V	469.00
Ameco PT 3 Pre Amp	99.00
Larsen 2-meter on glass	49.95
Anteco 2M, 5/8, Mag. Mount, Comp	25.00
Van Gordon G5RV	44.00
Bird 43, elements/stock	Call
Thousands of panel meters	3.95 up CALL
Belden 9913, 8267, 8214 Stock	Call
New Ten Tec Omni V DX rig extraordinaire	1895.00
MICA Capacitors	Call
Arista SWR Bridge 3-30 MHz	19.95
831SP-PL259 Silverplate (Amphenol)	1.50
82-61 N Male (Amphenol)	3.50
82-202-1006 N Male (9913)	3.50
Double Female UHF	1.00
UG176 RG8X	each .40
Surplus Elbow PL259-SO239	each $1
Receiving tubes 50-90% off list price	Call
Santec Boom Mike/Headset (fits ICOM)	20.00
Rohn SA 25G 67 (67 inside arm)	each 125.00
STUPH	
Throat Mike (new mil. surplus)	5.00
ANBH-1 600 Ω Headphones (new mil. surplus)	5.00
New Demo Units for Sale	
ICOM IC-575A, 275H, 375A	1100.00
ICOM IC-471H	800.00

USED EQUIPMENT

All equipment, used, clean, with 90 day warranty and 30 day trial. Six months full trade against new equipment. Sale price refunded if not satisfied.

(800) 231-3057

POLICIES

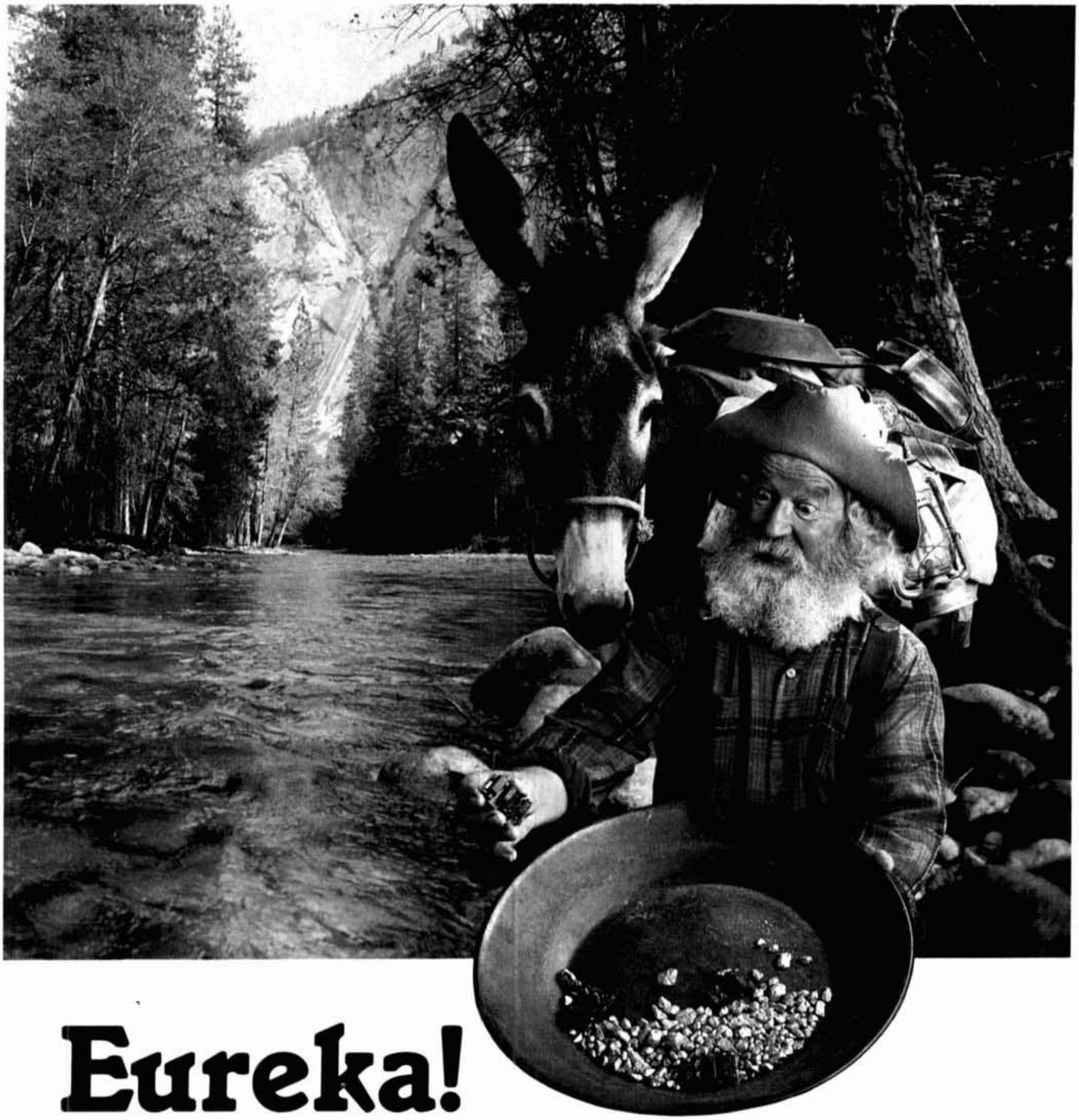
Minimum order $10.00. Mastercard, VISA, or C.O.D. All prices FOB Houston, except as noted. Prices subject to change without notice. Items subject to prior sale. Call anytime to check the status of your order. Texas residents add sales tax. All items full factory warranty plus Madison warranty.

Bird and Belden products in stock. Call today.

MADISON
Electronics Supply
3621 FANNIN
HOUSTON, TEXAS 77004

MasterCard VISA

✓ 140

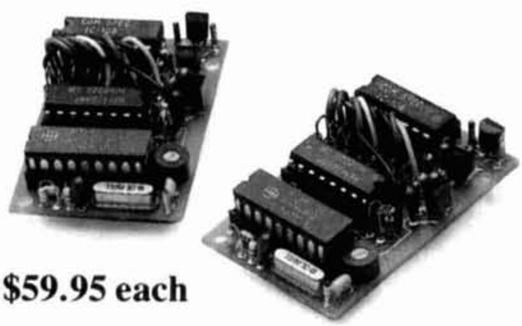


Eureka!

We just struck gold with a miniature, high quality and very reliable DTMF decoder at a rock bottom price of $59.95. Our DTD-1 will decode 5040, 4 digit codes with the security of wrong digit reset. It contains a crystal controlled, single chip DTMF decoder that works great in bad signal to noise environments and provides latched and momentary outputs. Why carry that heavy gear when its size is only 1.25 x 2.0 x .4 inches and it comes with our etched in stone, legendary, one year warranty.

Instead of sifting through the field…searching, use our super quick one day delivery and cash in on a rare find.

✓ 120



$59.95 each

COMMUNICATIONS SPECIALISTS

426 W. Taft Ave., Orange, CA 92665-4296
Local (714) 998-3021 • FAX (714) 974-3420
Entire U.S.A. 1-800-854-0547

master card

VISA

3 New Publications

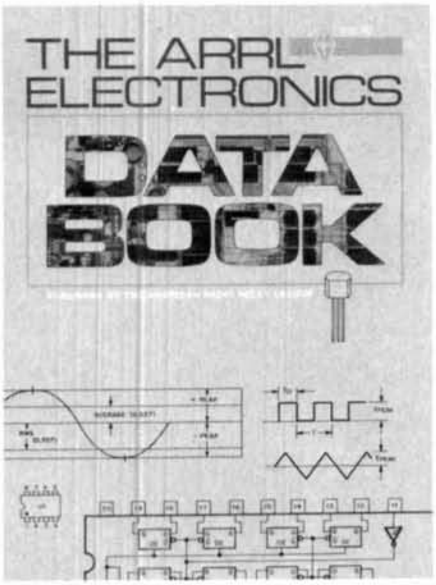
"A terrorist agent, representing an unknown foreign power or an internal subversive group, is bent on crippling or destroying America's space program by operating an illicit radio station from somewhere inside our Lost Padres National Forest wilderness area. A terrorist who has somehow gained access to our secret digital codes, launching schedules and classified radio frequencies required to cause our birds to self-destruct, during or after launch." And so begins a new adventure for Tommy Rockford, K6ATX.

Murder by QRM is packed with action. Join K6ATX on an ill-fated search using motorized hang-gliders and then as he backpacks through the wilderness in search of the hidden transmitter site. With the launch of the space shuttle *Conquistador* only hours away will Tommy be able to ferret out the culprits before the fatal destruct signal is sent?

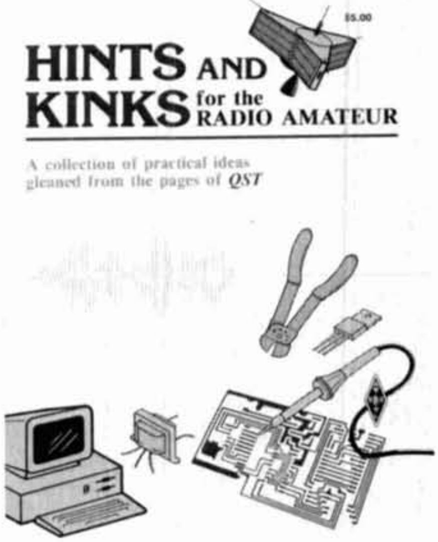
This is the sixth and final ham radio adventure by Walker Tompkins (the real K6ATX) who became a silent key just before the book was published. 194 pages, $5.00*

*For postage and handling add $2.50 ($3.50 for insured parcel post or UPS—please specify)

The ARRL Data Book is back by popular demand! Doug DeMaw, W1FB has completely revised and expanded the material in this handy reference for the RF design engineer, technician, radio amateur, and experimenter. This *one* source has all of those regularly used tables, charts, and those hard-to-remember formulas. You'll also find hundreds of popular circuit diagrams of oscillators, mixers, amplifiers, other active devices and their operating



parameters. This book can be used alone or to complement **The ARRL Handbook** and belongs in every technical library. Here's a brief summary and chapter lineup: **Symbols, Conversion Factors and Tables**; **Components and Materials** includes color codes, standard values, toroid selection charts; **Inductors and Transformers**; **Time and Frequency Measurement**; **Networks and Filters** covers attenuators and matching network design information; **Digital Basics** is 88 pages of logic, TTL Circuits, specific device descriptions, linear ICs, op-amp applications, and regulators; **Antennas and Transmission Lines**; **Catalog of Circuit Building Blocks** including audio amps, RF and IF small-signal amplifiers, mixers, FM detectors, oscillators, dc switches and amps, and frequency doublers; **Workshop and Lab Practices**. 234 pages, $12.00*



"Gimmicks and Gadgets, Tricks of the Trade." Since 1933, those words have been used describe **Hints and Kinks for the Radio Amateur**, but it has been almost seven years since the last edition appeared. Well, H&K fans, the long wait is over. The 12th in the series of the most popular *QST* "Hints and Kinks" contributions is now available, and hams like yourself share their innovations and wizardry. Like its predecessors, this edition has been said to be almost like having a radio club meeting on your bookshelf!

Here's just a sample: **In and Around the Station:** A Universal Equipment Stand, Safe Power Wiring Practices, Stop the Fire, Not Your Gear. **Transmitting and Receiving:** A Two-Transistor Transmitter for 30 Meters, Improvements for the HW-8, FT101ZD, TS830S, SB200, and SB220. **CW Hints:** Magnetic Switch for CW Tune Up, The Sneaky Knee Key for Mobile CW. **Computers and Digital Modes:** A Message-Waiting Indicator for TNCs, Tips for the VIC 20, TRS80 and Apple II. **Antennas and Feedlines:** Inexpensive 30 and 12-Meter Arrays, Retuning Traps for the WARC Bands, Baluns, Tower and Rotator tips. **Shop Secrets:** Tips on soldering and making PC Boards and more! **Tips on Testing:** Simple Logic Probe, plus 11 pages of test equipment and tips. **Portable and Mobile:** Power supplies, antennas, mobile installation tips. **VHF and UHF:** Antennas, amplifiers, CTCSS Tone Generator and more. **Power Supplies:** Power Supplies from Old Battery Chargers, High-Voltage Supply for Mobile Amplifiers. **Taming Interference:** Telephone RFI, TVI, CATVI cures. **Miscellanea:** COR and Timer Circuit, World-Time-Finder Slide Rule, AFSK System for FAX and more. 160 pages, $5.00*

ARRL, 225 MAIN STREET, NEWINGTON, CT 06111

112

(continued from page 6)

in Honolulu from 1934 to 1939 and was acquainted with Kenneth Lum King. He lived just a few blocks from where I lived for a time. I worked him while he was with the expedition on one of the Islands. I find in my log of November 21, 1935 at 4:45 PM Honolulu time that I took a message from him and phoned it to its destination. I also noted that the signal was very wobbly. As I recall, I had to keep turning my dial most of the time to copy him as he drifted too.

The mention of the China Clipper brings back memories. The day that it first arrived in Honolulu, I was camped with a group of school boys at Lailua on the beach and we heard on the radio that the Clipper was nearing the Island. We ran out on the beach and looked off to the east, and low on the horizon we could see this big four-engine airplane coming in. It had a letter on it for me from a girlfriend in California, and it was delivered a day or so later. When the Clipper was to return to San Francisco, I along with many others went out to Pearl Harbor to see it take off.

Walter M. Bolinger, N6UX,
K6BUX in 1935,
Keene, Texas 76059

Parts kit available from author

Dear HR

Thanks for publishing my article, "A Simple Low-cost Comb Generator Frequency Calibrator," in the July 1988 issue of your magazine.

I have received quite a bit of mail requesting parts for the project. I have therefore put together a complete kit of parts for $39.95 plus shipping and taxes. Individual parts are priced separately.

Could you please communicate this information to your readers?

Larry R. Martin, PO Box 997,
Sebastopol, California 95472

Consider it done! Ed.

ADVERTISER'S INDEX AND READER SERVICE NUMBERS

Listed below are the page and reader service number for each advertiser in this issue. For more information on their products, select the appropriate reader service number make a check mark in the space provided. Mail this form to *ham radio* Reader Service, I.C.A., P.O. Box 2558, Woburn, MA 01801.

Name ______________________ Call ______________

Address ______________________________________

City ______________ State ________ Zip __________

*Please contact this advertiser directly.

Please use before April 30, 1989.

PRODUCT REVIEW/NEW PRODUCT

OPTOELECTRONICS INC.

NEW

POCKET SIZE

SIZE: 4″ H x 3.5″ W x 1″ D
MADE IN USA

FREQUENCY COUNTERS

TO 2.4 GHZ

#TA-100S

8 LED DIGITS • 2 GATE TIMES
ALUMINUM CABINET
INTERNAL NI-CAD BATTERIES INCLUDED
AC ADAPTER/CHARGER INCLUDED

EXCELLENT SENSITIVITY & ACCURACY

AC-DC • PORTABLE OPERATION

Small enough to fit into a shirt pocket, our new 1.3 GHz and 2.4 GHz, 8 digit frequency counters are not toys! They can actually out perform units many times their size and price! Included are rechargeable Ni-Cad batteries installed inside the unit for hours of portable, cordless operation. The batteries are easily recharged using the AC adapter/charger supplied with the unit.

The excellent sensitivity of the 1300H/A makes it ideal for use with the telescoping RF pick-up antenna; accurately and easily measure transmit frequencies from handheld, fixed, or mobile radios such as: Police, firefighters, Ham, taxi, car telephone, aircraft, marine, etc. May be used for counter surveillance, locating hidden "bug" transmitters. Use with grid dip oscillator when designing and tuning antennas. May be used with a probe for measuring clock frequencies in computers, various digital circuitry or oscillators. Can be built into transmitters, signal generators and other devices to accurately monitor frequency.

The size, price and performance of these new instruments make them indispensible for technicians, engineers, schools, Hams, CBers, electronic hobbyists, short wave listeners, law enforcement personnel and many others.

STOCK NO:

#1300H/A	Model 1300H/A 1-1300 MHz counter with preamp, sensitivity, < 1mV, 27MHz to 450MHz includes Ni-Cad batteries and AC adapter	**$169.95**
#2400H	Model 2400H 10-2400 MHz microwave counter includes Ni-Cad batteries and AC adapter	**$299.95**
#CCA	Model CCA counter/counter, for debugging, ultra sensitive, < 50 micro volts at 150MHz! 1-600 MHz with adjustable threshold, RF indicator LED. Includes Ni-Cad batteries and AC adapter	**$299.95**

ACCESSORIES:

#TA-100S	Telescoping RF pick-up antenna with BNC connector	**$12.00**
#P-100	Probe, direct connection 50 ohm, BNC connector	**$20.00**
#CC-12	Carrying case, gray vinyl with zipper opening. Will hold a counter and #TA-1000S antenna.	**$10.00**

✓ 150

AVAILABLE NOW!

ORDER FACTORY DIRECT

FLA (305) 771-2050 **1-800-327-5912**

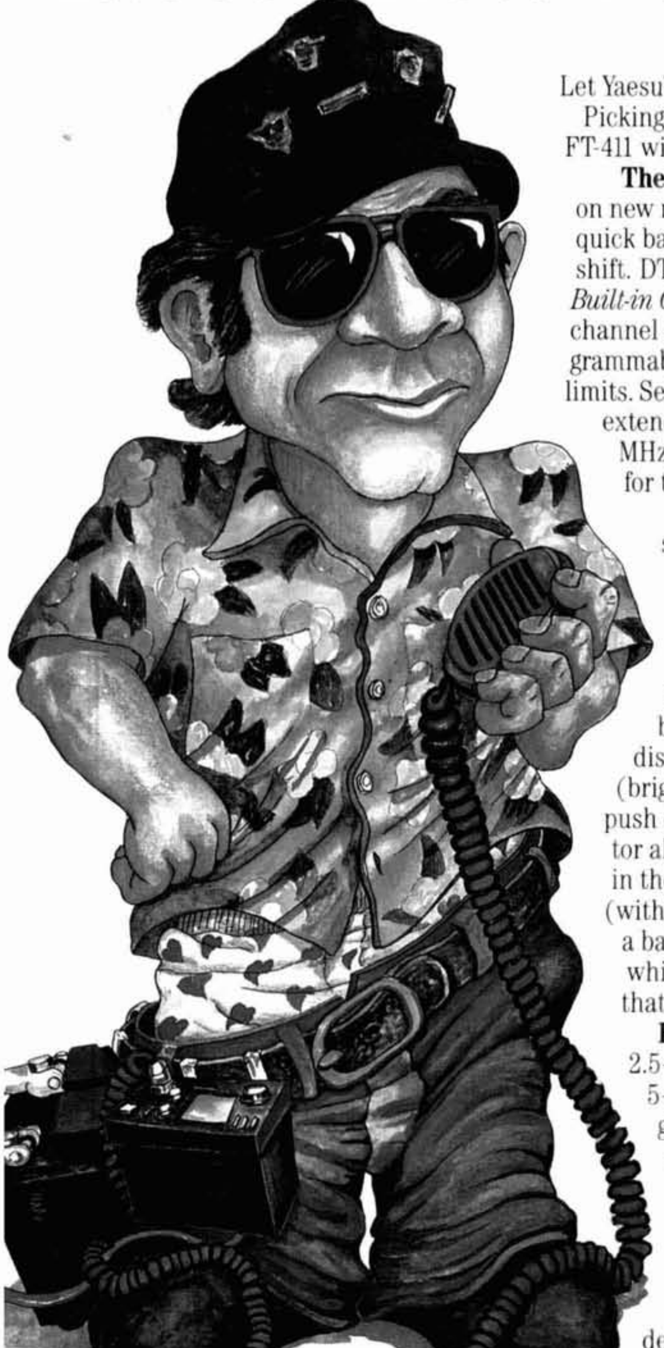
MasterCard VISA

OPTOELECTRONICS INC.

5821 N.E. 14th Avenue
Ft. Lauderdale. Florida 33334

Orders to US and Canada add 5% of total ($2 min, $10 max)
Florida residents add 6% sales tax. COD fee $2.
Foreign orders add 15%

You'll be hard-pressed to beat the performance of Yaesu's new FT-411 handheld.



Let Yaesu's "next generation" handheld lighten your load!

Picking up where our popular FT-209R Series left off, the 2-meter FT-411 will amaze with its astounding array of features!

The brains of a base station. "Sophisticated operation" takes on new meaning in the FT-411. You get 49 memories, plus dual VFOs for quick band-hopping. Keyboard frequency entry. Automatic repeater shift. DTMF autodialer with ten memories of up to 15 digits each. *Built-in CTCSS encode/decode.* Selectable channel steps: 5/10/12.5/20/25 kHz. Programmable band scan with upper/lower limits. Selectable memory scan. And extended receive coverage of 140-174 MHz (MARS/CAP permit required for transmit on 140-150 MHz).

Not bad for a handheld measuring just 55(w) x 32(d) x 139(h) mm (the same size as our FT-23R Series HTs)!

Friendly operation. For operating convenience, the FT-411's keypad features a "do-re-mi" audible command verification. Both the display and keypad can be backlit (brightly!) for night operation at the push of a button. A rotary channel selector allows fast manual tuning. Or key in the frequency directly. Operate VOX (with YH-2 headset option). Plus you get a battery saver to conserve power while monitoring. And a (defeatable) automatic power-off feature that shuts down your radio if you forget to turn it off!

High power capability. The FT-411 comes equipped with the 2.5-watt, 600-mAh FNB-10 battery pack. Try our optional FNB-12 5-watt, 500mAh pack or tiny FNB-9 2.5-watt, 200-mAh pack. Or get 6 watts output by applying 13.8-volts DC from an external power supply.

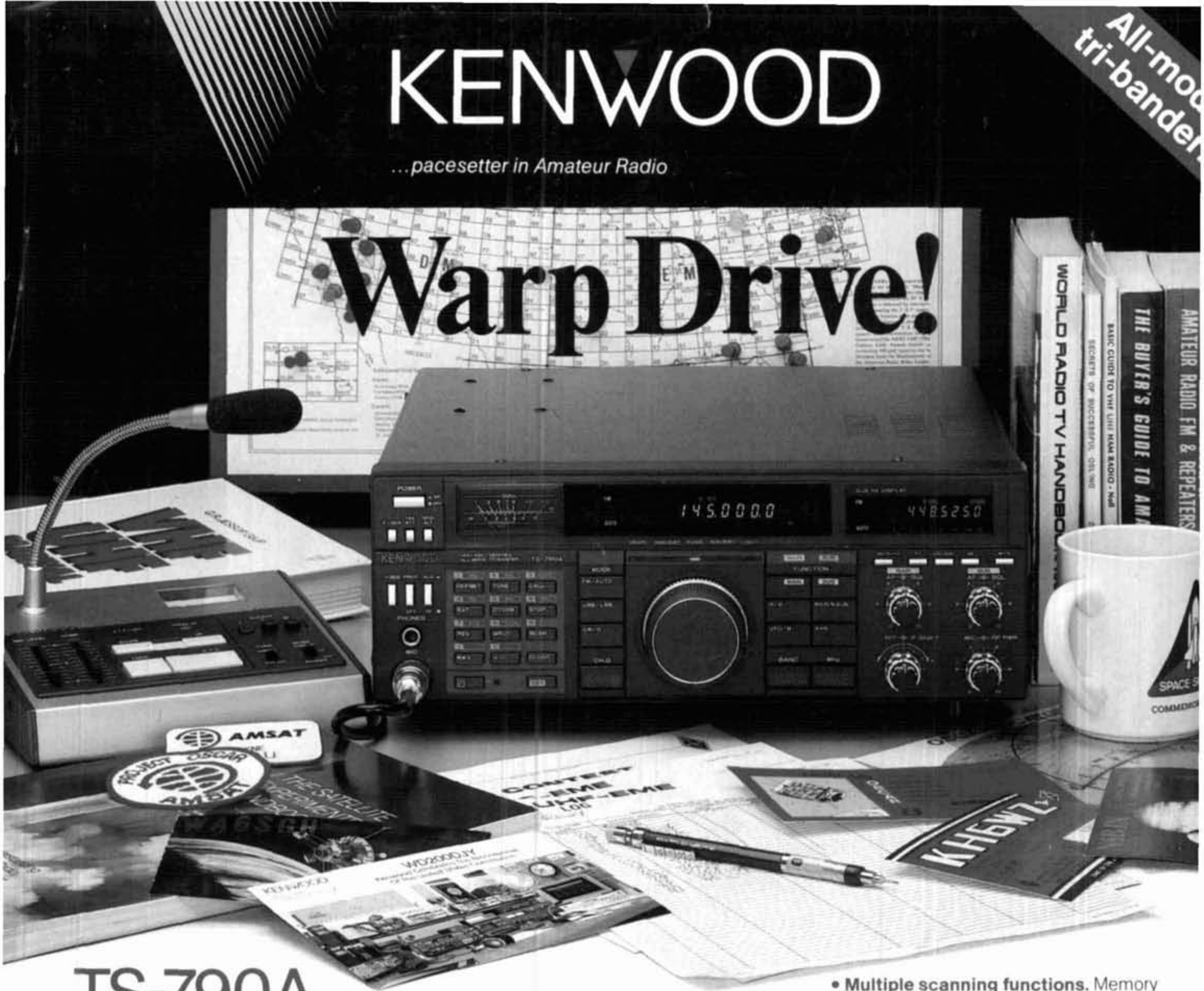
Swap options with Yaesu's FT-23R Series. Our rugged best-seller's chargers, batteries, and microphones are fully compatible with the FT-411. The FT-23R is the perfect companion for the FT-411, and at a great price!

Try out an FT-411 today. Ask for it now at your local Yaesu dealer. Or call 1-800-999-2070 for a free brochure. And experience the legendary Yaesu HT performance!

YAESU

✓ 168

Yaesu USA 17210 Edwards Road, Cerritos, CA 90701 (213) 404-2700. Repair Service: (213) 404-4884. Parts: (213) 404-4847. Prices and specifications subject to change without notice. Specifications guaranteed only within amateur bands.



TS-790A

Satellite Transceiver

The new Kenwood TS-790A VHF/UHF all-mode tri-band transceiver is designed for the VHF/UHF and satellite "power user." The new TS-790A is an all-mode 144/450/1200 MHz transceiver with many special enhancements such as Doppler shift compensation. Other features include dual receive, automatic mode selection, automatic repeater offset selection for FM repeater use, VFO or quick step channel tuning, direct keyboard frequency entry, 59 memory channels (10 channels for separate receive and transmit frequency storage), multiple scanning and multiple scan stop modes. The Automatic Lock Tuning (ALT) on 1200 MHz eliminates frequency drift. Power output is 45 watts on 144 MHz, 40 watts on 450 MHz, and 10 watts on 1200 MHz. (The 1200 MHz section is an optional module.)

- **High stability VFO.** The dual digital VFOs feature rock-stable TCXO (temperature compensated crystal oscillator) circuitry, with frequency stability of ±3 ppm.
- **Operates on 13.8 VDC.** Perfect for mountain-top DXpeditions!
- **The mode switches confirm USB, LSB, CW, or FM selection with Morse Code.**
- **Dual Watch allows reception of two bands at the same time.**
- **Automatic mode and automatic repeater offset selection.**
- **Direct keyboard frequency entry.**
- **59 multi-function memory channels.** Store frequency, mode, tone information, offset, and quick step function. Ten memory channels for "odd split."
- **CTCSS encoder built-in.** Optional TSU-5 enables sub-tone decode.
- **Memory scroll function.** This feature allows you to check memory contents without changing the VFO frequency.
- **Multiple scanning functions.** Memory channel lock-out is also provided.
- **ALT—Automatic Lock Tuning—on 1200 MHz eliminates drift!**
- **500 Hz CW filter built-in.**
- **Packet radio terminal.**
- **Interference reduction controls:** 10 dB RF attenuator on 2m, noise blanker, IF shift, selectable AGC, all mode squelch.
- **Other useful controls:** RF power output control, speech processor, dual muting, frequency lock switch, RIT.
- **Voice synthesizer option.**
- **Computer control option.**

Optional Accessories:

• **PS-31** Power supply • **SP-31** External speaker • **UT-10** 1200 MHz module • **VS-2** Voice synthesizer unit • **TSU-5** Programmable CTCSS decoder • **IF-232C** Computer interface • **MC-60A/MC-80/MC-85** Desk mics • **HS-5/HS-6** Headphones • **MC-43S** Hand mic • **PG-2S** Extra DC cable

Complete service manuals are available for all Kenwood transceivers and most accessories.
Specifications, features, and prices are subject to change without notice or obligation.

KENWOOD

KENWOOD U.S.A. CORPORATION
2201 E. Dominguez St., Long Beach, CA 90810
P.O. Box 22745, Long Beach, CA 90801-5745