

**40-CHANNEL CB  
NEW FCC RULES**  
see page 6

\$1.00 ■ OCT. 1976

# Radio-<sup>IND 34740</sup>Electronics®

THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

punch up your  
**CB PERFORMANCE**  
know about SWR

from our lab  
**2 HI-FI TESTS**  
of new gear

use IC's  
**OVERSPEED ALARMS**

build your own  
**DIGI-COLOR-ORGAN**  
add dancing lights

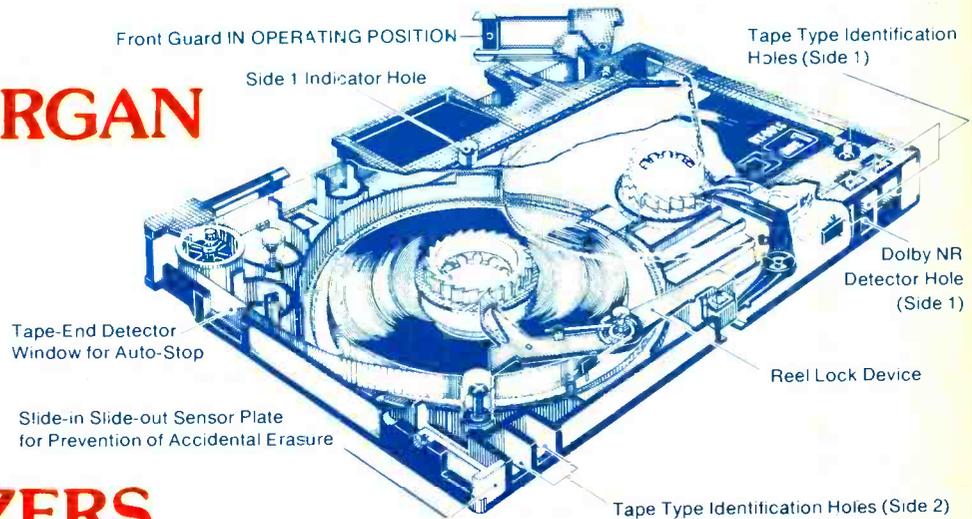
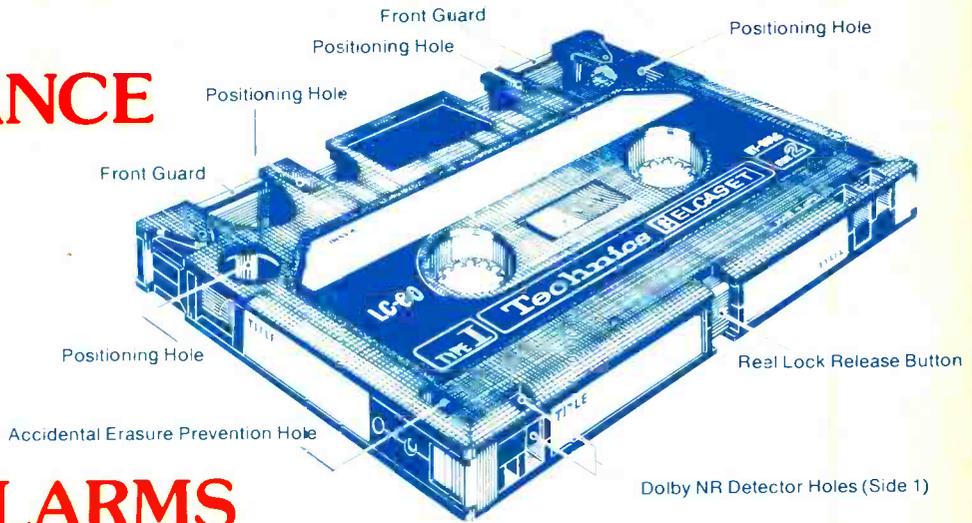
ready now  
**AM STEREO**  
broadcasting

how they work  
**CB SYNTHESIZERS**  
use fewer crystals

new tape format  
**"ELCASET"**  
for hi-fi

**PLUS**

- ★ Komputer Korner
- ★ Brainwave Monitor
- ★ Delayed Sweep Scopes
- ★ Jack Darr's Service Clinic



A  
GERNSBACK  
PUBLICATION



## Why is the 280 at \$99<sup>95</sup> our fastest selling multimeter ever?

The reasons are easy to understand. The 280 is a battery-operated portable, full-feature digital multimeter at less than the price of a precision analog meter. The 280 features a large three-digit LED readout, automatic polarity indication, automatic decimal point placement and out-of-range indication. The 280 is fully over-load protected for reliability and has an industry-standard input impedance of 10 megohms for all voltage ranges.

It has High/Low power ohms ranges for accurate in-circuit measurements. And digital accuracy  $\pm 0.5\%$  DCV thru lowest ranges;  $\pm 1\%$  1000 V range.  $\pm 1\%$  ACV thru lowest ranges;  $\pm 2\%$  1000V range.  $\pm 1\%$  typical ohms and digital resolution (1mV, 1 $\mu$ A, 0.1 ohm).

No compromises on range either—DC and AC voltage ranges to 1000 V, DC and AC current ranges to 1000 mA and ohms ranges to 10 megs. There are actually 22 operating ranges controlled by the smooth rotary range and function switches.

B&K-PRECISION also has a full complement of optional accessories for the 280:

- LC-28 carrying case (\$6.00) protects your 280 and provides test lead storage.
- MS-28 wire tilt stand (\$3.00) allows positioning the 280 on two convenient viewing angles.
- BC-28 AC adapter/charger (\$8.00) offers AC operation and battery recharging.
- PR-28 high-voltage probe extends the 280's capability to 40,000 volts.
- PR-21 direct/isolation probe (\$10.00) prevents capacitive loading when measuring DC in an RF circuit.

Our fastest seller ever? We're not surprised.  
**IN STOCK AT YOUR DISTRIBUTOR.**

**B&K PRECISION**

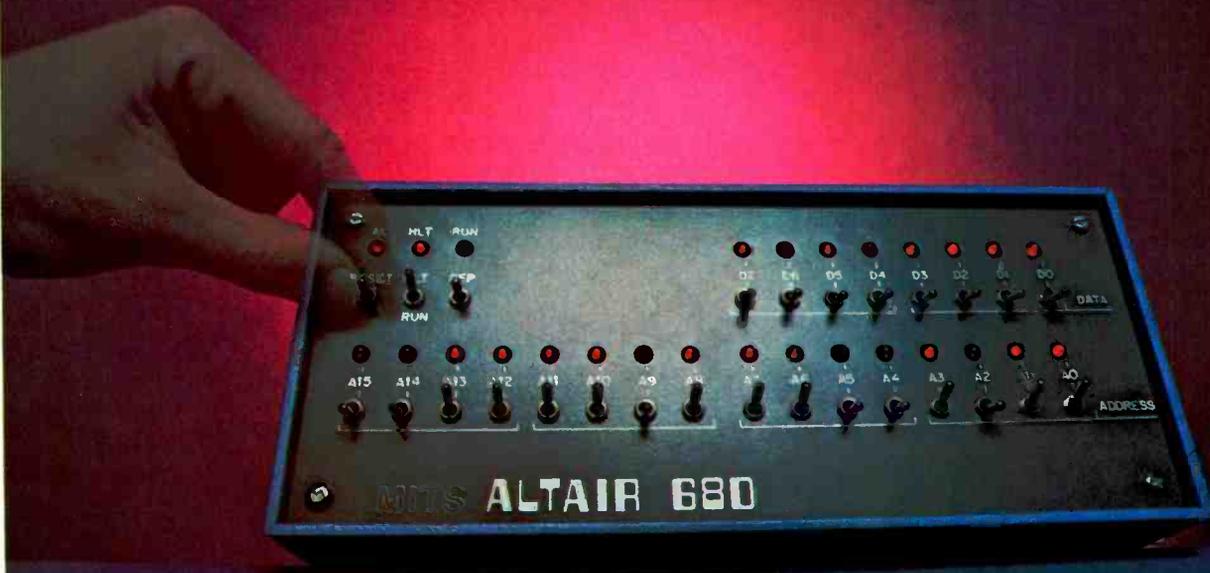
**PRODUCTS OF DYNASCAN**

6460 West Cortland Avenue • Chicago, Illinois 60635 • (312) 889-9087

In Canada: Atlas Electronics, Toronto

CIRCLE 72 ON FREE INFORMATION CARD

# The small wonder



# of the micro-World

Measuring just 11" wide x 11" deep x 5" high, and weighing a mere 7 pounds, the Altair™ 680b is a complete, general-purpose computer.

The secret to this revolutionary, small computer is its CPU board. This double-sided board fits along the bottom of the Altair case and plugs directly into the front panel board. It contains the new 6800 microprocessor, 1,024 bytes of RAM memory, a 256 byte PROM monitor, provisions for 768 bytes of additional PROM or ROM, and a single Interface port with a Motorola ACIA serial interface adapter which can be configured either RS-232 or TTY. A five level Baudot interface option is also available.

The Altair 680b can be programmed from front panel switches, or it can be interfaced to a video display terminal, or teletypewriter. Three additional circuit boards can be plugged inside the Altair 680b for further memory and interface expansion. The first of these boards is a 16K static RAM memory board.

Software already developed includes Altair 680 BASIC with all the features of the 8K BASIC previously developed for the Altair 8800. These include Boolean operators, the ability to read or write a byte from any I/O port or memory location, multiple statements per line, and the ability to interrupt program execution and then continue after the examination of variable values. This software takes only 6.8K bytes of memory space and a copy is included free with the purchase of the Altair 680 16K memory board.

Other software includes a resident two pass assembler (also free with 16K board) The Altair 680b is also compatible with Motorola 6800 software.

The Altair 680b is ideal for hobbyists who want a powerful computer system at an economic price. Altair 680b owners qualify

for membership in the Altair Users Group, and like other Altair owners, they receive a complimentary subscription to **Computer Notes** and complete factory support.

#### PRICES:

Altair 680b kit with complete, easy-to-understand assembly manual, operator's manual, and programming manual.....	\$466
Assembled Altair 680b.....	\$625
Altair 680b Turnkey model kit.....	\$395
Expander Card 680MB (required to expand 680).....	\$ 24
Altair 680BSM 16K static RAM board kit with 680 BASIC.....	\$685
Altair 680 BASIC when purchased separately.....	\$200
Baudot option.....	\$ 42

#### MAIL THIS COUPON TODAY

- Enclosed is a check for \$ \_\_\_\_\_  
 Bank Americard # \_\_\_\_\_ or Master Charge # \_\_\_\_\_  
 Altair 680b  Kit  Assembled  Other (specify) \_\_\_\_\_  
 enclose \$8 for postage and handling (Continental U.S. Others subject to quote)  
 Please send free information package.

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ STATE & ZIP \_\_\_\_\_



2450 Alamo SE/Albuquerque, NM 87106, 505-243-7821

NOTE: Altair is a trademark of MITS, Inc.

Price, specifications subject to change. Please allow up to 60 days for delivery

CIRCLE 47 ON FREE INFORMATION CARD

**The turntable  
nobody had heard of  
two years ago is  
now Number One.  
The most popular  
turntable in America.  
It's called a  
"bee eye cee."  
It's built five ways.  
And it's imported.  
From Michigan.**



Five ways means five models. And all five are belt drive turntables, with low speed (300 rpm) motor, program system, superior tone arm, and excellent performance characteristics. Read all about them in our "5 Turntables" folder or contact your B.I.C. representative.

Model 920 about \$79 - 940 about \$109 - 960 about \$159 - 980 about \$199 - 1000 about \$279 Model 980 shown ©1976 British Industries Co. A Division of Avnet Inc.

**5 Turntables B I C**

CIRCLE 81 ON FREE INFORMATION CARD

[www.americanradiohistory.com](http://www.americanradiohistory.com)

# Radio-Electronics®

THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

Electronics publishers since 1908

OCTOBER 1976 Vol. 47 No. 10

## CB RADIO

- 6 **40 CB Channels**  
The new FCC rules expand the band. Preview them here.
- 41 **CB Frequency Synthesizers**  
How they work and the circuits that are used.  
**by Robert F. Scott**
- 82 **SWR And Getting Out**  
The how, why and what to do about it.  
**by Herb Friedman**

## BUILD ONE OF THESE

- 45 **Overspeed Alarms For Your Car**  
Circuits and designs that help make you a safer driver.  
**by R.M. Marston**
- 61 **Digicolororgan**  
Stereo system divides each channel into 4-frequency bands. Add dancing lights to your hi-fi system. **by Dan Meyer**
- 77 **Mindpower: Alpha**  
*Part IV:* This concludes our coverage of a brainwave monitor with usual feedback through a television receiver.

## HI-FI STEREO AUDIO

- 48 **"ELCASET" A New Tape System**  
One-quarter-inch tape in a drop-in cassette. System prices start at \$800.00. **by Len Feldman**
- 51 **AM Stereo Ready Now**  
Two new systems now up for FCC approval.  
**by Harry Maynard**
- 58 **Mystery of The Tweeters**  
We know why they burn out unexpectedly; do you?  
**by Len Feldman**
- 69 **R-E Lab Test Report**  
Shure M24H CD-4 and stereo cartridge.  
**by Len Feldman**
- 70 **R-E Lab Test Report**  
Sansui model RU-9900 AM/FM tuner. **by Len Feldman**

## GENERAL ELECTRONICS

- 4 **Looking Ahead**  
Tomorrow's news today. **by David Lachenbruch**
- 22 **Komputer Korner**  
Accumulator I/O vs memory I/O.  
**by Jon Titus, Peter R. Rony and David G. Larsen**
- 26 **Komputer Korner II**  
*Part I:* 8080 instruction set. **by Tim Barry**

## TELEVISION

- 86 **Service Clinic**  
Stacked transistor IF stages. **by Jack Darr**
- 88 **Reader Questions**  
R-E's Service Editor solves reader problems.
- 95 **Step-By-Step Troubleshooting**  
Amplified burst reference oscillator. **by Jack Darr**

## TEST EQUIPMENT

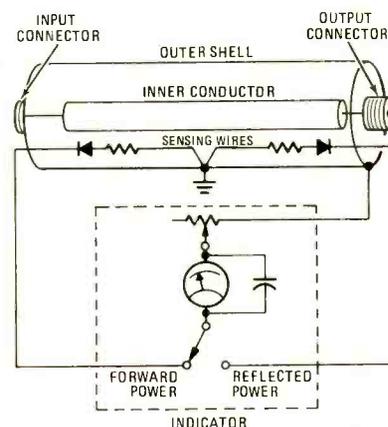
- 32 **Equipment Report**  
Hickok 380 frequency counters
- 34 **Equipment Report**  
Philips PM3225 dual trace scope
- 36 **Equipment Report**  
B & K 570 transistor tester
- 80 **Delayed Sweep Scopes**  
What it does and how to use it. **by Bill Glaze**

## DEPARTMENTS

- |                                  |                           |
|----------------------------------|---------------------------|
| 12 <b>Advertising Offices</b>    | 6 <b>New &amp; Timely</b> |
| 116 <b>Advertising Index</b>     | 105 <b>New Literature</b> |
| 117 <b>Free Information Card</b> | 98 <b>New Products</b>    |
| 14 <b>Letters</b>                | 115 <b>Next Month</b>     |
| 119 <b>Market Center</b>         |                           |

### ON THE COVER

Another new tape system. "Elcaset" puts 1/4-inch tape in an easy loading package. Three manufacturers have already announced equipment—Technics, Sony and Teac. For the whole story, turn to page 48.



SWR is vital to effective CB communications. Measure it and adjust it for best performance from your set. .... see page 82



Synthesizers reduce the crystal count in CB transceivers. .... see page 41

Radio-Electronics, Published monthly by Gernsback Publications, Inc., 200 Park Avenue South, New York, NY 10003. Phone: 212-777-6400. Second-class postage paid at New York, NY and additional mailing offices. One-year subscription rate: U.S.A., U.S. possessions and Canada, \$8.75. Pan-American countries, \$10.25. Other countries, \$10.75. Single copies \$1.00. © 1976 by Gernsback Publications, Inc. All rights reserved. Printed in U.S.A.

**Subscription Service:** Mail all subscription orders, changes, correspondence and Postmaster Notices of undelivered copies (Form 3579) to Radio-Electronics Subscription Service, Boulder, CO 80302.

A stamped self-addressed envelope must accompany all submitted manuscripts and/or artwork or photographs if their return is desired should they be rejected. We disclaim any responsibility for the loss or damage of manuscripts and/or artwork or photographs while in our possession or otherwise.

As a service to readers, Radio-Electronics publishes available plans or information relating to newsworthy products, techniques and scientific and technological developments. Because of possible variances in the quality and condition of materials and workmanship used by readers, Radio-Electronics disclaims any responsibility for the safe and proper functioning of reader-built projects based upon or from plans or information published in this magazine.

# looking ahead

## Obsolete CB's?

Expansion of the 23-channel Citizens band will *not* render current equipment obsolete. FCC Chairman Richard Wiley made that clear in answer to newspaper reports to the contrary. "No present CB sets will in any way be made obsolete," he said. "The FCC is very disturbed by any suggestions to the contrary." FCC Chief Engineer Raymond Spence suggested that currently available 23-channel sets are an especially good buy, since there will be less congestion on the existing channels after the new channels are opened up. There have been suggestions that 23-channel CB's are especially worth buying now because expanded-channel transceivers inevitably will cost more.

**Note:** The public doesn't seem to be worrying about obsolescence. As of last July, the FCC was processing 500,000 licenses a month and falling further behind each day. That compares with 30,000 licenses a month just two years ago.

## Cost of safety

The federal Consumer Product Safety Commission has a minor revolt on its hands. It commissioned Underwriters Laboratory to develop a mandatory TV safety standard—and the public-industry advisory committee voted overwhelmingly that the standard should be voluntary, not mandatory. Here's why: A mandatory safety standard covering such risks as shock, fire, portable TV handles and sharp edges, would add \$73 to \$92 to the cost of the average color set in 1977, according to the UL study, and \$12 to \$19 to the cost of a monochrome set. This works out to about \$1 billion added to TV price tags next year for safety. At the same time, past experience indicates that the damage caused by television sets with-

out the new safety standards would be somewhere between \$1,200,000 and \$9,700,000. This means that the proposed standard would cost 100 times more than it saves, in its first year alone.

Of course, the intangible and unfigurable part of the standard is the saving in human life. It's not known in any detail how many lives were lost as the result of unsafe TV's, or how many could be saved by the new safety measures. In total, it's known to be extremely small. But how much value do you put on a human being's life?

## Color tube sweepstakes

The war of the color tubes continues. Ever since Zenith announced a new tube using a completely new glass bulb designed for automated manufacture (**Radio-Electronics**, June 1976), other picture tube manufacturers have been manning the gunboats. Zenith and Corning (Corning designed the glass for the tube) had expressed hope that the new tube would become the industry standard.

But other tube manufacturers were not convinced. Sylvania embraced two aspects of the new tube—the 100-degree deflection angle and the tri-potential gun (which makes possible a small electron spot size with a slot mask), as described here last month. Now big RCA has made the rejection complete. RCA announced it will adopt the tri-potential gun in future 25-inch slot-mask tubes, but will stay at the current deflection angle of 90 degrees. Sylvania promptly announced that it would stay at 90 degrees and make the RCA-type tube if its set-making customers wanted it. Both Sylvania and RCA pointedly rejected the new "standard" glass that now seems to be the exclusive property of Zenith.

Such infighting is common in the picture-tube industry. If Zenith and Corning can prove that the new glass makes

possible a considerably less expensive picture tube, it wouldn't be surprising to see RCA and Sylvania go along—eventually. As Zenith President John Nevin put it, "it's not unusual for people not to be impressed with a design and later adopt it. They pooh-poohed Chromacolor for three years and then they all came out with copies of it."

## Fiber optics in TV

Fiber optics are in everyday use as a substitute for coaxial cable at Teleprompter Manhattan Cable TV, the first known use in the United States. Teleprompter has installed 800 feet of glass fiber to feed Home Box Office pay-TV programming into its cable system. The fiber being used has a loss of 16 dB per mile, compared with 62 dB for coax. One fiber could carry as many as 167 video channels. Teleprompter is using a light-emitting diode as the source for the modulated light, although presumably a semiconductor laser eventually will be used. Optical fibers have been in use for some time in the Netherlands for cable TV. Bell Telephone Laboratories is experimenting with fiber optics for carrying telephone communications near Atlanta. The fiber being used by Teleprompter is only 90 microns in diameter. A bundle of six of these could carry more than 1,000 TV channels. Most coaxial cable today has the capacity to carry only 20 channels.

## Projection TV

Fad or wave of the future? whatever it is, projection TV is being promoted by at least 30 manufacturers and assemblers, many of them local or regional.

Projection home TV isn't new—about 40,000 projection sets were sold from 1946 to 1949, in the days of television's infancy. The new sets, of course, are in color, but

many of them use the same principles as those earlier sets. What has been added is brighter picture sources and highly reflective screens, making it possible to view some sets in rooms that aren't totally darkened.

Advent Corporation has been the leader in home projection sets, and now has introduced its second three-tube model, at \$2,495. Most of the other manufacturers of home projection sets have single-tube units. A single-tube set generally consists of a small-screen color set (usually a Sony or a Toshiba) with an added lens system and special Kodak Ektalite highly reflective light-concentrating screen. Most of these single-tube units have 32 × 40-inch screens, in contrast to the 41 × 60-inch (six feet diagonal) used by Advent. Prices of the single-tube sets vary from about \$895 to \$3,000.

In addition to the already-assembled projection sets are the projection-TV kits that let you build your own projection set using a small-screen color set, lens and screen. These vary in price from \$39.95 for one of dubious merit up to \$895 without TV set. (**Radio-Electronics** will have a feature article covering projection TV in our December, 1976, issue.—*Editor*)

The crying need in home projection TV is more brightness, to do away with the necessity of turning out the lights and using special light-amplifying screens. This probably means a substitute for the cathode-ray tube as a picture-and-light source. Some work is being done in this direction, but there's no timetable for any concrete results.

Total sales of home projection-TV systems probably will be less than 50,000 units—maybe far less (nobody's keeping track)—this year, and maybe 100,000 to 150,000 next year. Even the highest figure is about equal to one week's sales of direct-view television sets.

**DAVID LACHENBRUCH**  
CONTRIBUTING EDITOR

# change tips... change temperatures

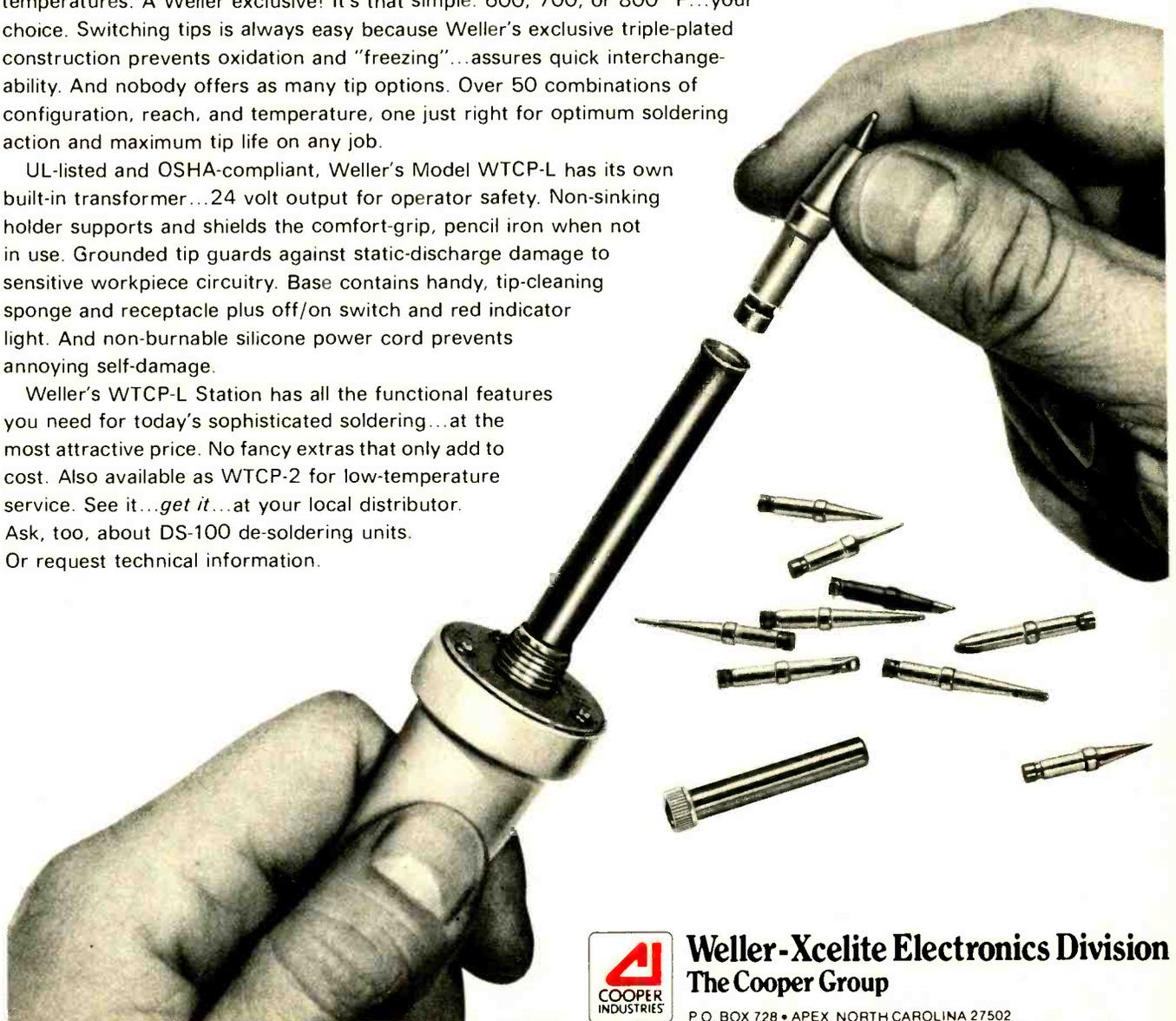


## Weller<sup>®</sup> CONTROLLED OUTPUT SOLDERING STATION

**...has interchangeable brains** in the form of a ferromagnetic sensor mounted in the tip that controls iron temperature through unique "closed-loop" circuit. Change tips...change temperatures. A Weller exclusive! It's that simple. 600, 700, or 800° F...your choice. Switching tips is always easy because Weller's exclusive triple-plated construction prevents oxidation and "freezing"...assures quick interchangeability. And nobody offers as many tip options. Over 50 combinations of configuration, reach, and temperature, one just right for optimum soldering action and maximum tip life on any job.

UL-listed and OSHA-compliant, Weller's Model WTCP-L has its own built-in transformer...24 volt output for operator safety. Non-sinking holder supports and shields the comfort-grip, pencil iron when not in use. Grounded tip guards against static-discharge damage to sensitive workpiece circuitry. Base contains handy, tip-cleaning sponge and receptacle plus off/on switch and red indicator light. And non-burnable silicone power cord prevents annoying self-damage.

Weller's WTCP-L Station has all the functional features you need for today's sophisticated soldering...at the most attractive price. No fancy extras that only add to cost. Also available as WTCP-2 for low-temperature service. See it...*get it*...at your local distributor. Ask, too, about DS-100 de-soldering units. Or request technical information.



**Weller-Xcelite Electronics Division**  
**The Cooper Group**

P.O. BOX 728 • APEX, NORTH CAROLINA 27502

CIRCLE 22 ON FREE INFORMATION CARD

## IT'S 40 CHANNELS FOR CB EFFECTIVE JANUARY 1, 1977

Seventeen new CB (Class D) channels will be added to the present 23 by new FCC rules. They become effective January 1, 1977. The only effect on the current channels is that 27.085 MHz (Channel 11), now a "calling only" channel, loses that restriction.

The new channels begin at 27.235 MHz and end at 27.405 MHz, with uniform spacing at 10-kHz intervals. Non-CB licensees that are now authorized to use this band—about 4000 land-mobile stations with authorized power up to 30 watts—will have to shift to other frequencies no later than December 1, 1979 when their existing licenses expire. During the three-year transitional period, these non-CB licensees will not receive CB-interference protection nor will CB stations be protected against the relatively high-power land-mobile gear.

The existing Channel 9 remains reserved for emergency use. All 40 channels can be used for SSB operations—either upper or lower sideband operation is OK. Channel number designations have been removed from the rules by the FCC. They state that, effective January 1, each channel will be identified by its authorized center frequency only. The reason is that two channels have been added between the existing Channels 22 & 23. The EIA has proposed that these two channels be labeled Channels 24 & 25 so the numbers

would run 22-24-25-23-26-etc.

The FCC also said that no action to reallocate the existing 27-MHz Class-C channels to Class D will be made at this time. Eventually, however, alternate channels must be found to supplant the present 27-MHz Class-C channels because of the increasing problem of interference by Class-D users to Class-C radio-control operations. Since no such alternate frequencies are presently available and because of significant investment in 27-MHz radio-control equipment by modelers, reallocation now is premature.

The suppression requirement for harmonic radiation is increased to 60-dB for all new transmitters sold. Compliance must be demonstrated both with and without the connection of all permissible attachments for use with such transmitters. This includes external speakers, microphones, power cords and antennas. A further reduction of harmonic radiation will be needed in the future and the FCC has proposed a minimum of 70 dB with some groups recommending that it should be as high as 100 dB. In the meantime, if an individual CB licensee causes interference to a neighbor's reception on TV channels 2, 5 or 6 because of insufficient harmonic attenuation, the CB operator will have to obtain additional suppression by inserting a low-pass filter between the RF

output connector and the antenna feed-line.

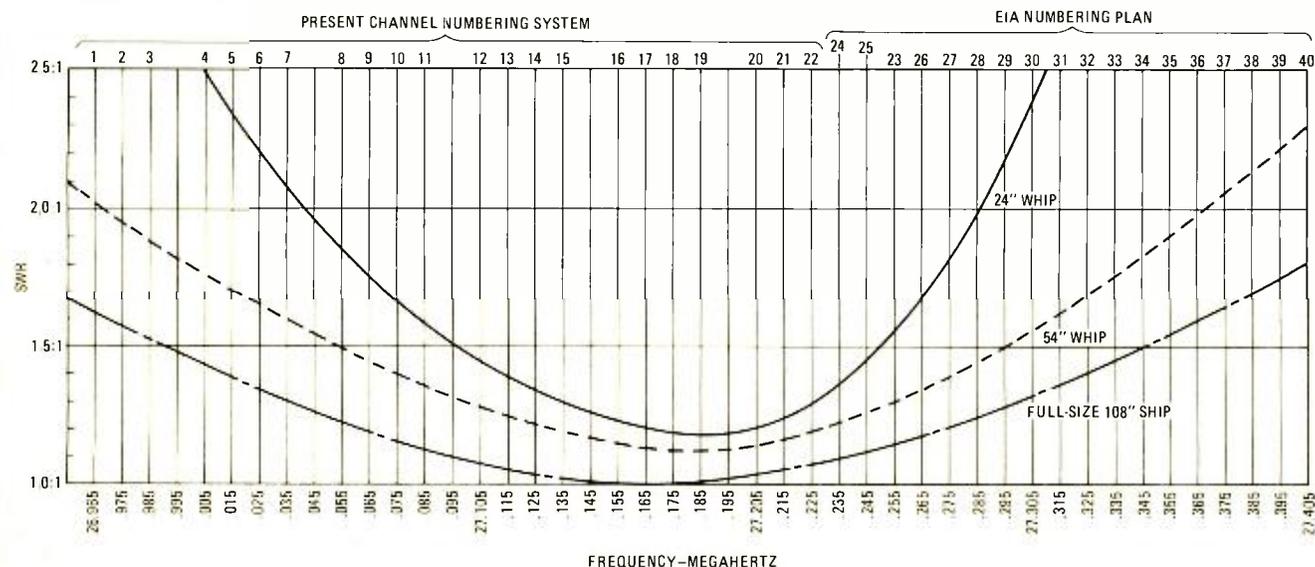
A copy of part 95 of the FCC rules and forms 505 (CB application form) and 55-B (temporary CB license) must be included with each new Class-D transmitter sold.

It will not be possible under the new rules to modify existing equipment to cover the additional channels. The manufacture, sale or attachment of any device, whether it is internal or external to the transmitter, that is intended to extend the frequency coverage of a Class-D transmitter beyond its original frequency range is prohibited. This includes kits, installed by a technician or even if installed by the factory. Manufacturers can, however, modify units before sale if the modified units are type accepted.

Frequency selectors are no longer limited to a single front-panel control. This means that keyboards, thumbwheel switches, etc., are OK to use.

No equipment built to operate on the new frequencies can be sold before January 1, 1977. No applications for type acceptance will be accepted by the FCC before September 10, 1976. All applications submitted before November 1, will be assigned an effective date of January 1, 1977. Applications submitted after November 1, will be given an effective date in order of grant. As a result, there

*continued on page 111*



**EXPANSION OF THE CITIZENS BAND will make greater demands on antenna design and performance. Some antennas, particularly the shorter mobile whips, perform best over just a few channels on each side of resonance. SWR and losses rise as you tune away from the channel to which the antenna is tuned. The curves compare the SWR's of a full-length quarter-wave whip and two shorter coil-loaded types.**

# THE 2-VOLUME WEBSTER'S 9-POUND, 1,380 PAGE, 158,000-DEFINITION \$39.95 DICTIONARY NOW ONLY \$19.95!

Can you imagine The New Webster International Dictionary of the English Language as a victim of recession? It is true! And just as the automakers offered rebates to drastically improve sales, so does Webster announce an incredible half-price slash of the publishers list price of \$39.95 to an unbelievable \$19.95 on the 1,380-page, nine-pound, 158,000-definition, 196-page supplemented, 2-volume, 1976 edition of **The New Webster International Dictionary of the English Language**. Now Only \$19.95.

Think of it! This 2-volume reference work for home, school or office library has never before been offered at such an extraordinarily low price. The many years of exhaustive research are clearly reflected in this supreme lexicographic effort. From this research and from suggestions, contributions and critical review by such notables and men of letters as Charles C. Collingwood, Chief Foreign Correspondent, CBS; Radio and Television Commentator and Mark Van Doren, Ph.D.; Author; Poet; Professor Emeritus of English, Columbia University, a most respected and distinguished permanent editorial staff labored unstintingly for additional arduous years to give you what has culminated in this priceless, non-pareil etymological endeavor. Everyday, literally hundreds of thousands of people refer to **The New Webster International Dictionary of the English Language**.

The work itself is a joy to peruse and is printed in large, easy-to-read type. It begins with A Historical Sketch of the English Language by Mario Pei, Professor Emeritus at Columbia University. The vocabulary, A-Z, is included in 1,185 pages, with even the most modern of colloquialisms well defined. This section is prefaced with A Guide to the Use of The Dictionary and tables for the pronunciation symbols and abbreviations used therein. Also included is a dictionary of Prefixes and Suffixes with etymologies and meanings.

Other supplements include:

- A phenomenal 51,000-word thesaurus of Synonyms and Antonyms with 4,000 precise cross references—an invaluable adjunct that no dictionary can be without.
- Idiomatic Foreign Words and Phrases—French, Latin, Greek, Spanish, Italian, etc., pronounced and translated into English—a must with our present day emphasis on multi-lingualism.
- Over 2,500 abbreviations set forth and defined—an acronymic treasure house.
- Musical signs, symbols and abbreviations set forth and explained for even the novice.



Noah Webster (1758-1843). Father of lexicography and inspiration for founding of our company.

● Your knowledge of popular and famous quotations lends credence to your literary background. Hundreds of these priceless comments on a myriad of people, places and things makes this section, in many ways, the crown jewel of supplements. "The wisdom of the wise, and the experience of the ages, may be preserved by quotations."—Disraeli.

● Seven sections comprise the Students' and Writers' Guide; truly a complete reference in itself for high school, college, home and office. The pen is still mightier than the sword!

● Do you want an exact date between 1901 and 2100 AD? This precise, simple, perpetual calendar will keep you ahead of the times, up to date or behind the times. You'll always have the right date.

● Metric or United States (Imperial)—we're here to convert you—and make it quick and easy—in our world of number systems such conversion tables are a necessity.

● Our Occupational Guide lists dozens of jobs and professions with appropriate explanations of necessary training, salary ranges and job availabilities, etc. PLUS an extensive listing of National organizations and addresses that can lead you to the job of your choice.

● The awe-inspiring adventures of both Greek and Roman mythology are detailed in abridged form with appropriate cross references. Constant literary reference to these immortal people and stories makes this section a storehouse of interpretive information.

● The Secretaries' Guide and Manual of Information is a commercial course in itself. It holds the key to being a successful secretary giving detailed and explicit information on the position, office routine, letter writing and filing with complete, accurate and up to date subdivisions for each.

● Multiplication and Compound Interest Tables will ease your way through our "buy it on the installment plan" life. Precise, simple and accurate—if you don't pay cash, know what your purchase costs really are.

● Keep track of your own wages and salary. Timekeepers do make mistakes. These simple, accurate tables permit you to swiftly discover errors of computation in time spans as small as 15 minute periods.

● Most of our lives we eat, sleep and work by the clock. Our magnificent charts will swiftly show you the exact time, on a comparison basis, anywhere in the world—all 24 time zones are at your fingertips.

● 8 pages of exciting, colored reproductions of the flags and banners of the world—a real history lesson.

And now all this can be yours. Two huge, handsome volumes that set on a library shelf will add a touch of grace, splendor, knowledge and erudition to your office or den. **The New Webster International Dictionary of the English Language** has never before been offered at such an astonishingly low \$19.95.

Here is our no-risk offer. Send for this beautiful dictionary of dictionaries today. Keep it for 14 days. Thumb through it as often as you wish. You must agree that it is the most thorough and comprehensive dictionary ever published, the one that defines every subtle nuance of a living, pulsating language—or return for a prompt and courteous refund.

**The New Webster International Dictionary of the English Language**, which lists at \$39.95 is now only \$19.95. Add \$2 for shipping. Hurry and order today. Credit card buyers may phone us toll free at 800-241-8444. Ask for Operator 516. In Georgia Only it is 800-282-1333. In Canada it is 1-800-261-6362. Or you may mail payment with the coupon below.

This recession-induced, money-raising, half-price sale may never be repeated. Write or call now while supplies last. Our toll-free lines are open 24 hours a day, 7 days a week. Allow 3-8 weeks for delivery.

## Credit Card Buyers

Phone Toll Free  
800-241-8444 Or

Mail No-Risk Coupon Today

**The Webster Dictionary Company, Inc.,  
Executive Offices,  
Dept. RES-61, Suite 500, 625 North Michigan Ave.,  
Chicago, Illinois 60611**

Please send me \_\_\_ set(s) of the renowned, authoritative, 2-volume, 1,380-page, 9-pound, 158,000-definition, \$39.95 list price **New Webster International Dictionary of the English Language** at the unprecedented low price of only \$19.95 each!! (plus \$2 per set for crating and freight). I understand that if I'm not satisfied I may return within 14 days for a prompt and courteous refund. On that basis, here is my order.

(Check one)

I enclose payment

Bill my credit-card account:

American Express # \_\_\_\_\_

BankAmericard # \_\_\_\_\_

Master Charge # \_\_\_\_\_ Inter-Bank # \_\_\_\_\_

Card Expiration Date \_\_\_\_\_

Name \_\_\_\_\_

Address \_\_\_\_\_

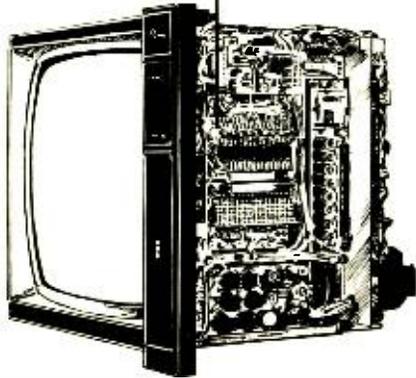
\_\_\_\_\_ Apt. \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Illinois residents please add 4% sales tax.

© Copyright 1976 The Webster Dictionary Company, Inc.

# Three different schools give you this 25" DIAGONAL hobby-kit Color TV...



No other home training school gives you both an exclusive solid state color TV, and an SQ® Quadraphonic Receiver complete with four speakers . . . all in one course. You get both for hundreds of dollars less than the combined tuition cost of TV and Audio courses at another school. And only NRI's Master Course in Color TV/Audio servicing lets you train on equipment specifically designed for training with exclusive "power-on" features. NRI doesn't give you hobby kits or commercial sub-assemblies. We invested the time and money to design equipment with learning in mind.

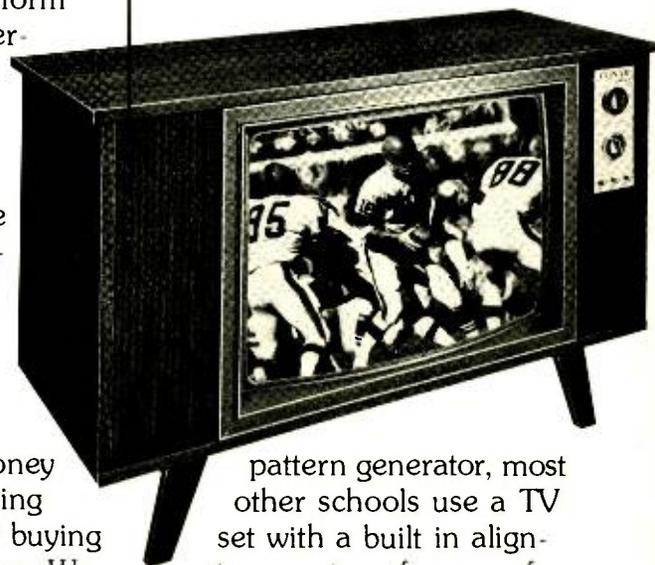
# Only NRI gives you this 25" DIAGONAL designed-for-learning Color TV...

It's the only way you can (1) get the feel of typical commercial circuitry, (2) learn bench techniques while building complete units from the "ground" up, (3) perform over 35 "in-set" experiments during construction, and (4) end up with a 25" diagonal solid-state color TV with console cabinet and a 4-channel quadrasonic Audio Center.

## **NRI passes the savings on to you**

NRI can save you money because our engineering eliminates the cost of buying from an outside source. We pay no salesman's commission. Students are enrolled by mail only. The savings are passed on to you in the form of low tuition fees, extras like the TV's console cabinet and the four speaker Quadraphonic System; a 5" triggered sweep

oscilloscope, CMOS digital frequency counter, and an integrated circuit color TV pattern generator. Where NRI supplies a professional color



pattern generator, most other schools use a TV set with a built in alignment generator of no use for servicing other sets. Only NRI designs, engineers, and supplies training kits specifically for learning and professional use. You can pay hundreds of dollars more for a similar course and not get a nickel's worth more in training and equipment.

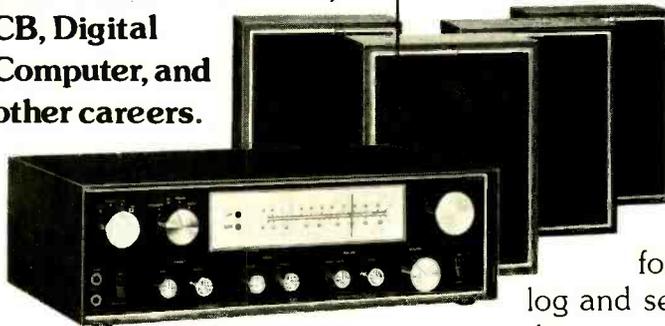
# ...plus complete Quadraphonic Audio Center!

## More know-how per dollar

That's what it all boils down to, the quality of training you get for the money you spend. In our 62-year history, more than a million students have come to NRI and we're fully approved for career study under the G.I. Bill. We must be teaching something right. Some of those "right" things are bite-size lessons to ease understanding and speed learning . . . personal consultation, and prompt grading of all tests . . . a full-time staff of engineer/instructors to help if you need it . . . plenty of kits and experiments to give you hands-on training . . . and fully professional

programs oriented to full or part-time career needs.

**Widest Choice of Courses with Communications, CB, Digital Computer, and other careers.**



NRI offers not one, but five excellent TV/Audio servicing courses so you can tailor your training to your budget.

Or you can study other opportunity fields like Digital Computer Electronics, Citizens Band Radio, Communications, Aircraft or Marine Electronics, Mobile Radio, and more. Send for our free catalog and see for yourself that no one gives you more training and equipment for your dollar. There's no obligation, and no salesman will call.

If card is missing, write to:



**NRI SCHOOLS**  
McGraw-Hill Continuing  
Education Center  
3939 Wisconsin Avenue,  
Washington, D.C. 20016



## Heating effect of radio waves reduces or destroys cancers?

Work carried on by Dr. Harry LeVeen at the Veterans Administration Hospital in Brooklyn indicates that radio waves can reduce the size of malignant tumors and destroy cancerous tissue. Using a frequency of 13.56 MHz, Dr. LeVeen reduced the size of malignant tumors in 21 cases of advanced cancer and destroyed the cancerous tissue in some of them. As the cases were all far advanced, none of the patients were permanently helped, however.

The effect, Dr. LeVeen explains, is due to heat. The tissue in the cancer was heated to an average of 119 degrees Fahrenheit, more than hot enough to kill either cancerous or normal tissue. The reason normal tissue in the area was not damaged is that blood circulation is better in normal tissue. Thus the blood carried the heat away and the normal tissues remained at a temperature considerably below that of the cancerous ones.

Attitude of cancer authorities appears to be that the experiments are encouraging, but that carefully controlled clinical tests will be required to determine what role, if any, the new technique will play in cancer therapy.

## Citizens band radio service helps the country mailman

Rural mail carrier Chet Lane, who operates the 47-mile Route 3 out of Boise, Idaho, finds a CB radio a valuable help in his work, and the families along his route are getting better parcel post service and other advantages because of it.

More than a third of the 460 families along RR 3 have CB radios in their homes, Chet Lane estimates, and the number is growing. When he has a parcel too large for the rural mailbox, Lane calls the house and lets the family know he will be coming with a package. He can also let a customer know the amount of a COD shipment while he is still a few minutes from the home, giving the family time to get the funds together. Or he can notify the recipient of a piece of certified mail.

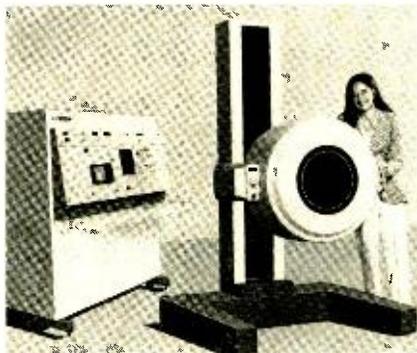
CB-equipped families along the route also make occasional use of the CB link. Families might ask Lane to drop off a roll of stamps.

## New gamma-ray camera assures high resolution

A new generation of gamma cameras was unveiled by Raytheon at the Dallas summer meeting of the Society of Nuclear Medicine.

A gamma camera is one that senses radiation (short X-rays) from a patient's body. Certain organs have an affinity for

particular radioactive materials. The patient is injected with a small amount of radioactive material that is then detected by the camera and converted to an image that can be read by nuclear physicians.



THE RAYTHEON CAMERAY XL-91 with its control console in the background

The *Cameray* XL-91 has a 16.5-inch undistorted field of view. This extra-large field can often mean the difference between complete and incomplete views of an organ or whole-body images. Former wide-field cameras have not had as fine image resolution as smaller ones. The XL-91 uses 91 tubes instead of the 37 tubes of earlier types, assuring resolution equal in all respects to cameras with a smaller field of view.

## New system to make more calls on fewer lines

Bell Labs, together with AT&T's Long Lines system, is testing between New York and Boston a technique that should make possible a great increase in the information carrying capacity of a telephone voice channel.

The system, known as Time Assignment Speech Interpolation (TASI), takes advantage of normal pauses in telephone conversations in an "occupied" communications channel. The ordinary phone conversation is full of pauses, sometimes occupying more than half the time of the conversation. TASI routes another conversation over the line during those "unused" periods. When the person who paused starts speaking again, the conversation goes over the first available open line.

An earlier TASI system, introduced in 1960, effectively doubled the capacity of undersea cables between the United States and Europe. That system worked with ordinary voice conversations and an individual voice processing circuit was needed for each channel. In the new system, the voice signals are converted into digital form, and a single high-speed digital circuit can process a large number of voice channels. **R-E**

# Radio-Electronics®

Hugo Gernsback (1884-1967) founder  
M. Harvey Gernsback, KOD-6694  
editor-in-chief and publisher  
Larry Steckler, KTX-3644, CET, editor  
Robert F. Scott, CET, W2PWG,  
KXK-8533, technical editor  
Arthur Kleiman, KTZ-3288, associate  
editor

Jack Darr, CET service editor

Leonard Feldman

contributing high-fidelity editor

Karl Savon, semiconductor editor

David Lachenbruch, contributing editor

Rudolph F. Graf, contributing editor

George Whalen, contributing editor

Vincent P. Cicenja, production manager

Dale Allinson, production assistant

Harriet I. Matysko, circulation director

Sheila Wertling, circulation assistant

Arline R. Bailey, advertising coordinator

Cover design by Louis G. Rubsamen

Cover photo by Walter Herstatt

Radio Electronics is a member of the *Institute of High Fidelity* and is indexed in *Applied Science & Technology Index* and *Readers Guide to Periodical Literature*.



Radio-Electronics magazine is published by Gernsback Publications, Inc. 200 Park Ave. S., New York, NY 10003 (212) 777-6400

President: M. Harvey Gernsback

Vice President: Larry Steckler

Treasurer: Carol A. Gernsback

Secretary: Bertina Baer

## ADVERTISING SALES

### EAST

Stanley Levitan, KZA-5580, Sales Manager  
Radio-Electronics  
200 Park Ave. South  
New York, NY 10003  
(212) 777-6400

### MIDWEST/Texas/Arkansas/Okla.

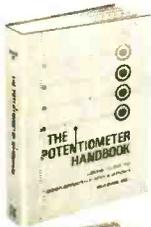
Ralph Bergen, KXD-8396  
Jim Reilly  
The Ralph Bergen Co.  
6319 N. Central Ave.  
Chicago, IL 60646  
(312) 792-3646

### PACIFIC COAST Mountain States

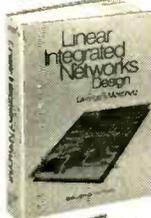
Jay Eisenberg, KYF-3277  
J.E. Publishers Representative Co.,  
8732 Sunset Blvd.,  
4th Floor,  
Los Angeles, CA 90069  
(213) 659-3810  
Sales Mart Building  
1485 Bayshore Blvd., Box 140  
San Francisco, CA 94124  
(415) 467-0125

### SOUTHEAST

J.E. Publishers Representative Co.,  
214-387-2424



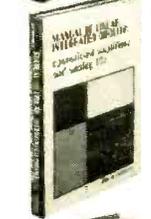
066/906  
**THE POTENTIOMETER HANDBOOK**  
by Bourns, Inc.  
Pub. price, \$14.50  
Club price, \$10.95



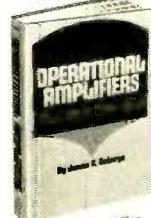
771/758  
**LINEAR INTEGRATED NETWORKS: Design**  
by G. S. Moschytz  
Pub. price, \$29.95  
Club price, \$21.95



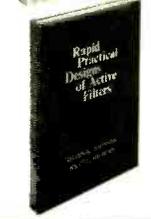
767/009  
**DIGITAL SIGNAL PROCESSING**  
by A. V. Oppenheim & R. W. Schaffer  
Pub. price, \$22.95  
Club price, \$17.95



766/746  
**MANUAL OF LINEAR INTEGRATED CIRCUITS**  
by S. D. Prentiss  
Pub. price, \$16.95  
Club price, \$13.50



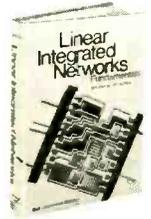
772/371  
**OPERATIONAL AMPLIFIERS: Theory & Practice**  
by J. K. Roberge  
Pub. price, \$18.95  
Club price, \$14.95



767/556  
**RAPID PRACTICAL DESIGNS OF ACTIVE FILTERS**  
by D. E. Johnson & J. L. Hilburn  
Pub. price, \$15.00  
Club price, \$11.50



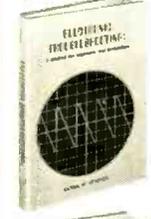
766/274  
**ELECTRONIC TECHNICIAN'S HANDBOOK OF TIME-SAVERS AND SHORTCUTS**  
by C. G. Grolle  
Pub. price, \$12.95  
Club price, \$7.95



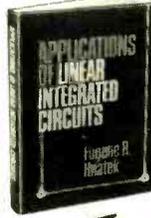
771/731  
**LINEAR INTEGRATED NETWORKS: Fundamentals**  
by G. S. Moschytz  
Pub. price, \$29.95  
Club price, \$21.95



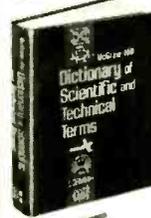
766/789  
**HIGH FREQUENCY AMPLIFIERS**  
by R. S. Carson  
Pub. price, \$14.95  
Club price, \$11.50



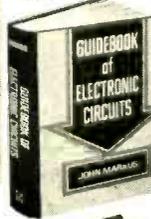
771/189  
**ELECTRONIC TROUBLESHOOTING**  
by C. N. Herrick  
Pub. price, \$13.95  
Club price, \$10.95



771/332  
**APPLICATIONS OF LINEAR INTEGRATED CIRCUITS**  
by E. R. Hnatek  
Pub. price, \$26.95  
Club price, \$19.50



452/571  
**DICTIONARY OF SCIENTIFIC & TECHNICAL TERMS**  
by McGraw-Hill  
Pub. price, \$39.50  
Club price, \$29.50



404/453  
**GUIDEBOOK OF ELECTRONIC CIRCUITS**  
by J. Markus  
Pub. price, \$26.95  
Club price, \$21.50



124/485  
**ELECTRICAL ENGINEERING FOR PROFESSIONAL ENGINEERS' EXAMINATIONS, 3/e**  
by J. D. Constance  
Pub. price, \$17.00  
Club price, \$12.50

## Introductory offer to new members of the **ELECTRONICS AND CONTROL ENGINEERS' BOOK CLUB**

any one  
of these great  
professional books  
for only **\$1.00**  
values up  
to **\$39.50**

Special \$1.00 bonus book comes to you  
with your first club selection

## save time and money by joining the **ELECTRONICS AND CONTROL ENGINEERS' BOOK CLUB**



Here is a professional book club designed to meet your on-the-job engineering needs by providing practical books in your field on a regular basis at below publisher prices. If you're missing out on important technical literature—if today's high cost of reading curbs the growth of your library—here's the solution to your problem.

The *Electronics and Control Engineers' Book Club* was organized for you, to provide an economical reading program that cannot fail to be of value. Administered by the McGraw-Hill Book Company, all books are chosen by qualified editors and consultants. Their understanding of the standards and values of the literature in your field guarantees the appropriateness of the selections.

How the club operates: Every month you receive free of charge *The Electronics and Control Engineers' Book Club Bulletin*. This announces and describes the Club's featured book of the month as well as alternate selections available at special members' prices. If you want to examine the Club's feature of the month, you do nothing. If you prefer one of the alternate selections—or if you want no book at all—you notify the Club by returning the card enclosed with each Bulletin.

As a Club member, you agree only to the purchase of four books (including your first selection) over a two-year period. Considering the many books published annually, there will surely be at least four you would want to own anyway. By joining the Club, you save both money and the trouble of searching for the best books.

MAIL THIS COUPON TODAY

CIRCLE 34 ON FREE INFORMATION

# FREE EICO CATALOG

358 Ways  
To Save On  
Instruments,  
Citizens Band,  
Burglar Alarms,  
Automotive &  
Hobby  
Electronics!

The more you know about electronics, the more you'll appreciate EICO. We have a wide range of products for you to choose from, each designed to provide you with the most pleasure and quality performance for your money. The fact that more than 3 million EICO products are in use attests to their quality.

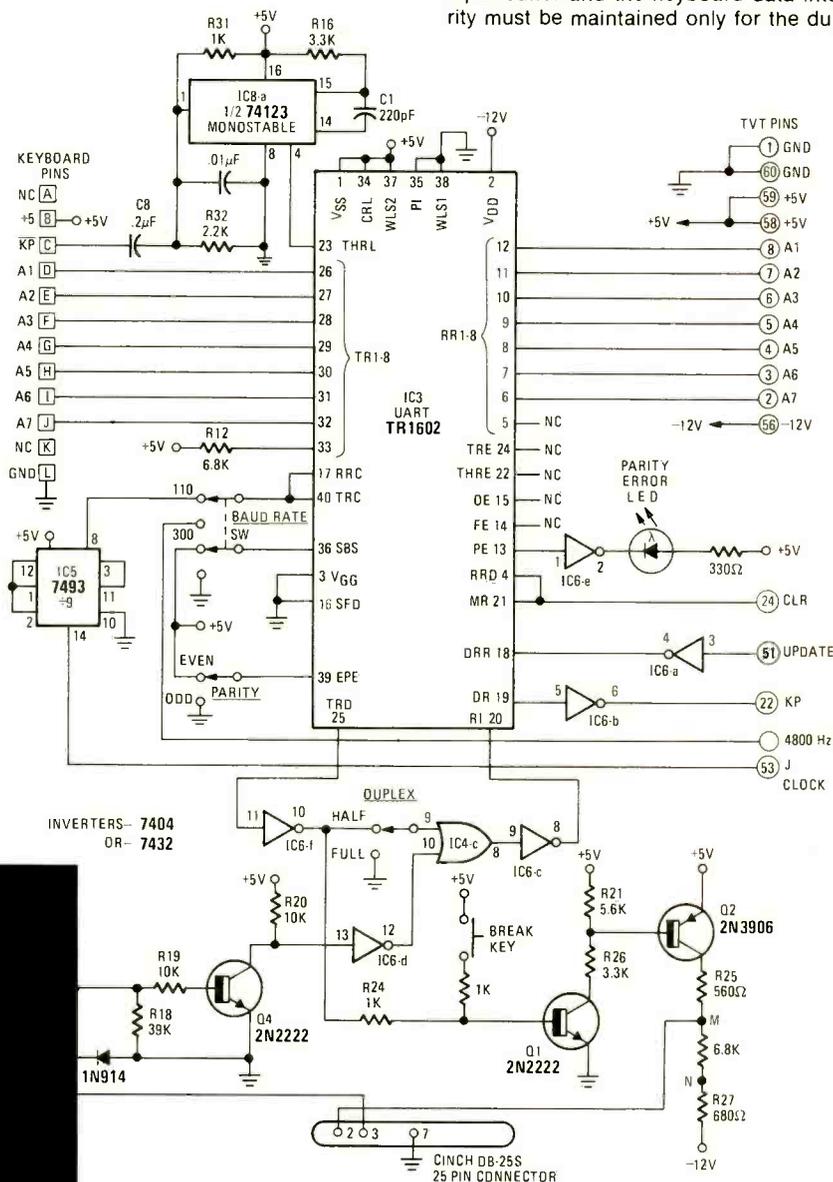
# letters

## TVT-I UART RS 232 INTERFACE

I further modified Raymond Crandell's modification of Roger Smith's TVT-I UART board (February 1975) to provide an RS-232 compatible interface. I have also added selectable baud rate, even/odd parity, half/full duplex switches, a break key, and a received parity error light. This has enabled the use of the terminal with a

Q1 and Q2 is now +5V rather than the original +12V. With this change, the 6.8K resistor added to the Q2 collector circuit, and the signal inversions, the transmit voltage levels are -3.5V for mark and +3.5V for space.

The TVT-I actually performs better with the UART located between the keyboard and the memory because it acts as an input buffer and the keyboard data integrity must be maintained only for the dura-



modem on a large timesharing  
and also with an Altair 8800 with  
option on its serial interface  
modifications are shown in the

original IC4 (7400) on the board  
replaced with a 7432 quad OR gate,  
with the same pin assignments. Also  
the positive supply voltage for

tion of the IC8 stobe, rather than for the  
full screen refresh time as previously  
required.

The TV Typewriter has been the most  
interesting electronics construction pro-  
ject that I have encountered and I am very  
happy with the results.

LARRY L. KENAN  
Phoenix, AZ

continued on page 16

# SBE OPTI/SCAN.

## The scanner that's only a light beam away from 16,000 frequencies.

OPTI/SCAN is, without question, the world's most advanced scanning receiver. It is the only crystal-less scanner that optically scans any station in the nation by the use of programmed cards with permanent memory. Simply program and insert the card, OPTI/SCAN does the rest. You can change cards even while driving without taking your eyes off the road. Built-in AC/DC operation.

Who needs a system as advanced as OPTI/SCAN? Anyone anywhere who wants a digital scanning receiver that will be ahead of all the others for years to come.



**SBE** Better Communications through Creative Technology

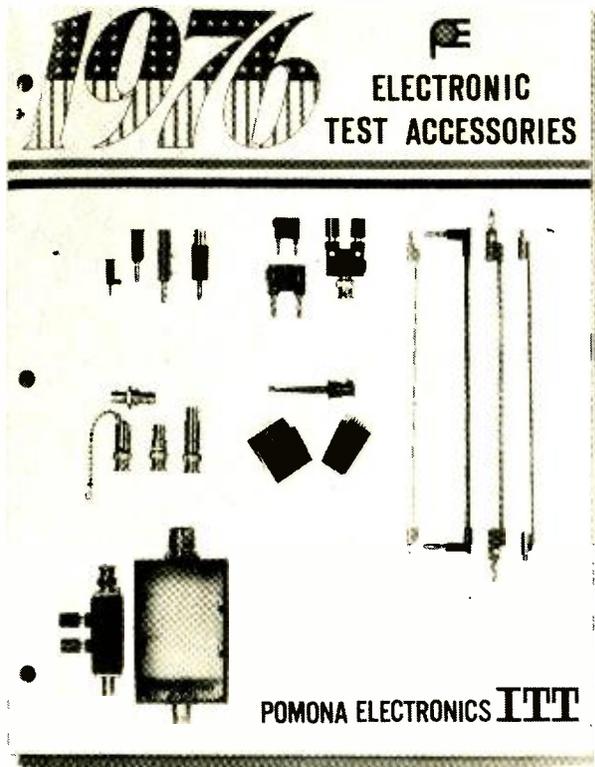
For information write: SBE, Inc., 220 Airport Blvd., Watsonville, CA 95076

INTERNATIONAL OFFICES: E. S. Gould Marketing Co. Ltd. 109 Montee de Liesse, Montreal, Quebec, Canada H4T 1S9 • Linear Systems, S.A. 5 Rue des Alpes, P.O. Box 163, 1211 Geneva 1, Switzerland

CIRCLE 31 ON FREE INFORMATION CARD

[www.americanradiohistory.com](http://www.americanradiohistory.com)

# MEET OUR FAMILY OF ELECTRONIC TEST ACCESSORIES



This new General Catalog is our latest family portrait. In the past twenty-five years (1976 is our Silver Anniversary year) it has grown from a handful of items to almost 500 products for the electronics industry.

Our catalog has grown to 76 pages for 1976, and we are introducing 65 new items this year. It describes and illustrates every member of our family. You're bound to find the solution to your testing problem with one or more of these quality products.

For your free copy, circle the reader service number listed below, or write:

## ITT POMONA ELECTRONICS

1500 East Ninth St., Pomona, Calif. 91766  
Telephone (714) 623-3463. TWX: 910-581-3822



CIRCLE 32 ON FREE INFORMATION CARD

### LETTERS

*continued from page 14*

#### GOLKA PHOTOGRAPH

I was interested to read of my friend Robert Golka's lightning experiments in the June issue of **Radio-Electronics**, and to see the photograph I took of the scientist playing lightning rod to a 12 million volt discharge.

Mr. Golka is to be commended for his single minded inquiry into the mysteries of ball lightning, a pursuit that has taken him far from the comforts of Brockton, Massachusetts, to the relative barrenness of Wendover, Utah, where he is known locally as the "mad scientist." As for the so-called Golka associates, I have met only two: a flop-eared mongrel dog named Captain Proton and a borderline canine that answers to the grandiloquent title of Commander Klystron.

I don't know whether anyone will be interested in technical details about the photo, but just in case; I shot it with a Bronica and a 135-mm lens, set up on a tripod and aimed at the top of Golka's Tesla coil. While the power was off, Robert sat on the top of the ladder and I snapped him with a couple of strobe lights. Then I removed the film back, rewound the shutter and made a second exposure of about a minute at f/8 with the sparks flying and all of us at a safe distance. So I ended up with a double exposure on Ektachrome, which we transferred to a negative and then to a print.

A note that may be of some interest: the cavernous hangar where Mr. Golka conducts his lightning experiments was originally built to house the Enola Gay, the B-29 that dropped the atom bomb on Hiroshima. Should the scientist ever succeed in harnessing nuclear fusion, it would be an event of historical significance equal to, I hope, the dawn of atomic warfare. And a brighter milestone in human progress, I might add.

RICHARD MENZIES  
Salt Lake City, UT

#### NEW SQ DECODER?

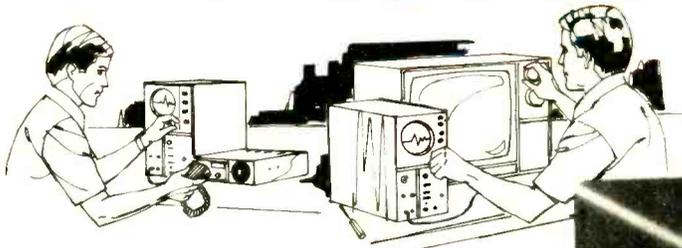
I would like to apprise you of a most interesting discovery I made in the early days of SQ but whose time appears to have arrived only now: listening to an SQ quadriphonic record played in the stereo mode through binaural earphones gives an unmistakable impression of hearing a decoded quadriphonic program—the human head appears to act to a notable extent as an SQ decoder.

This phenomenon occurs with any good pair of binaural earphones—currently I am using the AKG-K240. The SQ record is not played through a decoder—it simply is reproduced like any stereo record in the binaural earphones. Naturally, the more "discrete" the SQ record, the greater the effect. For example, if you play Side-A Band-7 (*Channel Identification Signals*) of the SQ-T-1100 Quadriphonic Test Record, you hear the pink noise tones walk around your head. The Boulez/Bartok MQ32132 is equally startling in this effect. And the Freiburg MQ32933 is a delight with its spatiality.

*continued on page 18*

# Simpson®

## 12 MHz Triggered Sweep 5" Oscilloscope



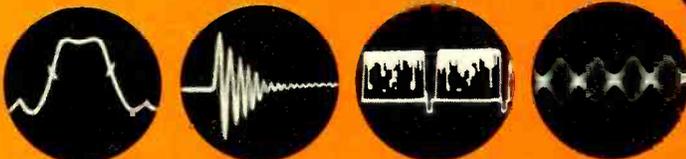
**MODEL 455T**

### 19 Calibrated Sweep Speeds plus TVH, TVV, VITS

- DC—12 MHz with smooth rolloff, useable through the "CB" 27 MHz band
- Voltage-calibrated vertical inputs (9 steps)
- Vertical dual inputs, switch selected
- Exclusive gate output for flyback tests
- Fast 30 nanosecond rise time
- Triggering—internal, external and line with three TV sync positions
- Z-Axis intensity modulation input
- .5 V P-P 1 KHz square wave calibrator
- All solid-state circuitry (except CRT)
- Bright blue trace
- Price \$395  
10 to 1 probe \$18.40



### APPLICATIONS: General TV, Radio, CB and Industrial Service



TV alignment curve with markers inserted

Ringing test on flyback

Composite video signal sync at horizontal blanking rate

27 MHz "CB" modulation envelope

Also: voltage, time, or frequency measurements; vector displays; plus square wave testing; phase shift measurements; feedback stability tests; peaking and nulling tuned circuits.

**Simpson**  
INSTRUMENTS THAT STAY ACCURATE

**SIMPSON ELECTRIC COMPANY**

853 Dundee Avenue, Elgin, Illinois 60120  
(312) 697-2260



ORDER FROM YOUR SIMPSON ELECTRONICS DISTRIBUTOR

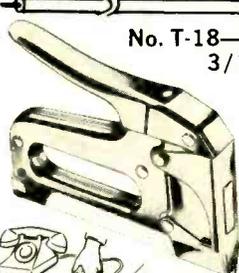
CIRCLE 19 ON FREE INFORMATION CARD

# ARROW AUTOMATIC STAPLE GUNS

## CUT WIRE & CABLE INSTALLATION COSTS

... without cutting into insulation!

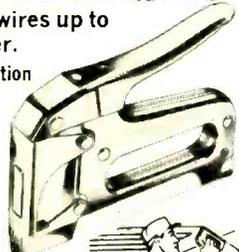
**SAFE!** Grooved Guide positions wire for proper staple envelopment! Grooved Driving Blade stops staple at right depth of penetration to prevent cutting into wire or cable insulation!



**No. T-18—Fits wires up to 3/16" in diameter.**

**BELL, TELEPHONE, THERMOSTAT, INTERCOM, BURGLAR ALARM and other low voltage wiring.**

Uses T-18 staples with 3/16" round crown in 3/8" and 7/16" leg lengths.



**No. T-25—Fits wires up to 1/4" in diameter.**

Same basic construction and fastens same wires as No. T-18.

Also used for **RADIANT HEAT WIRE**

Uses T-25 staples with 1/4" round crown in 9/32", 3/8", 7/16" and 9/16" leg lengths.

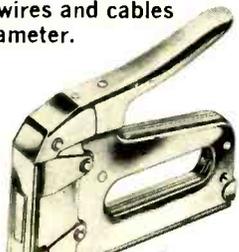


**NEW! Intermediate No. T-37—Fits wires and cables up to 5/16" in diameter.**

Same basic construction as Nos. T-18 & T-25.

Also used for **CATV and DRIVE RINGS in stringing wires.**

Uses T-37 staples with 5/16" round crown in 3/8", 1/2" and 9/16" leg lengths.



**No. T-75—Fits wires and cables up to 1/2" in diameter.**

**RADIANT HEAT CABLE, UF CABLE, WIRE CONDUIT COPPER TUBING or any non-metallic sheathed cable.**

Also used as **DRIVE RINGS in stringing wires.**

Uses T-75 staples with 1/2" flat crown in 9/16", 5/8" and 7/8" leg lengths.

ARROW FASTENER COMPANY, INC.

271 Mayhill Street, Saddle Brook, N. J. 07663

## LETTERS

continued from page 16

I call this SQ dichophony. I have found that perception of SQ dichophony varies from individual to individual but about 90% of those tested unmistakably experienced it. It appears, therefore, that SQ dichophony is bound to have a significant influence upon the enjoyment of reproduced sound.

A good measure of harmony exists between what the Germans call "Kunzkopfstereophonie"—listening binaurally with a dummy head—and SQ dichophony. Those who seek spatial effects through the use of dummy heads will find an equal or greater measure of enjoyment by listening to SQ records played undecoded into binaural headphones.

Now that we know of SQ dichophony, the concern of headphone manufacturers that the growing popularity of quadraphony may require them to produce special headphone designs is groundless; rather, SQ dichophony enhances the use of conventional high-fidelity stereophonic headphones.

Naturally, SQ dichophony cannot replace quadraphonic listening with loudspeakers—it is not possible to equate earphones with the live sensation of the quadraphonic space. But as a means of simple, low cost, personal, non-disturbing enjoyment of music, I believe you will find SQ dichophony a significant advance.

BENJAMIN B. BAUER  
Vice President and General Manager  
CBS Technology Center  
Stamford, CT

## A NEW FORCE?

A very important concept was brought out in the June 1976 article about Golka and "12-Million Volts." The idea of "re-creating the past to solve future needs" caught my attention.

Over 150 years ago, Oersted discovered a tiny force that causes a permanent magnet to turn at right angles to a current-carrying conductor. He didn't know it but he could have substituted an iron wire for the compass needle although he would not have been able to determine North from South. In all this time we have not been able to produce a permanent magnet that has a magnetic field similar to the one around a current-carrying conductor.

Anytime we find a new force, no matter how tiny, big things begin to happen. Modify Oersted's experiment. Obtain a straight iron-wire 12-inches long that has the same diameter as a current-carrying conductor and suspend it 1/16-inch below and in parallel with the current-carrying conductor with three loops of thread. No matter which way the current flows in the current-carrying conductor, the iron wire is always lifted. How can we describe and use this new force?

We know if current flows in the same direction in two parallel conductors, they attract each other. Reverse the current in one conductor and they repel each other. There is no current in the iron wire yet it is always attracted. Why?

JOHN W. ECKLIN  
Alexandria, VA

## LOW-FREQUENCY METER

In reference to a letter that appeared in your July, 1976 issue, Fluke has another way to make low frequency measurements (10 Hz to 10 kHz) fast and accurately. It is the Fluke 1920A frequency counter with option -06 (Resolution Multiplier Option).

With this unit, period measurements and taking reciprocal numbers is not necessary. Using a one second gate-time will yield a 60,000-Hz reading with the 1920A-06. The 1920A-06 uses a phase-locked loop to multiply the incoming signal by  $\times 1000$ .

DON TUTTLE  
Regional Sales Engineer  
John Fluke Mfg. Co., Inc.  
Mountlake Terrace, WA

## ELECTRONIC STOPWATCH

I built the Electronic Stopwatch from the article that appeared in the November, 1975 and February, 1976 issues of **Radio-Electronics**. Rather than use another case as stated in the article, I used the original calculator case but with an edge spacer that I formed from a strip of plastic (1/8"  $\times$  11/16"  $\times$  15 1/2"-inches) using a heat gun (actually a modified hair dryer) and soldering iron for bending, molding and joining the expander between the two



halves of the original calculator case. This worked out well for me and I am quite happy with the results.

I used a Novus Mathbox model 650. In so doing I ran into a few problems. The Mathbox has a different hook-up on the 75492 digit driver from that shown in your schematics. Except for making allowance for the modified digit driver hook-up, I followed your schematics with the result of good functioning stopwatch.

A.M. LACAVA  
Tustin, CA

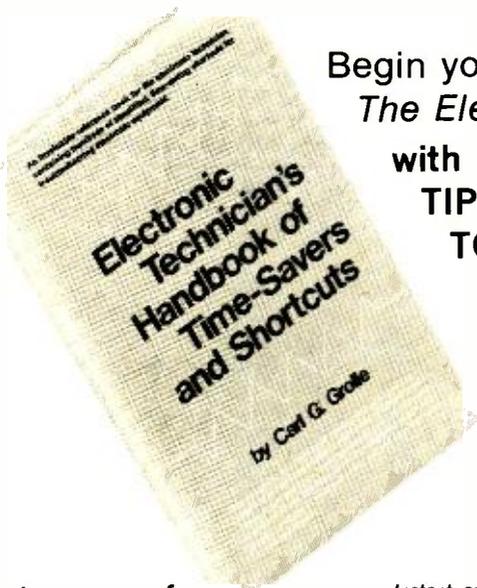
## CANADIAN COMPUTER CLUB

Will you please list our computer club in your magazine? The name of our club is TRACE (Toronto Region Association of Computer Enthusiasts) and we have over 50 members in the greater Toronto, Hamilton, and Kitchner, Ontario areas. We meet once a month, usually on the first or second Friday. Details are in our newsletter.

HAROLD MELANSON  
President, TRACE  
Box 545  
Streetsville, Ontario L5M 2C1

Sure I will.—Editor

R-E



## Begin your risk-free membership in The Electronics Book Service

with this reference that CONTAINS HUNDREDS OF TIPS THAT ELIMINATE HOURS OF TIME AND TOIL IN TROUBLESHOOTING, THAT CAN HELP SEND YOUR EARNINGS UP FAST.  
Publisher's price: \$12.95.

# YOURS FOR JUST \$1.98!

This treasury of troubleshooting tips provides ready solutions to problems in every major area of electronics. It contains hundreds of time-saving shortcuts and techniques for troubleshooting all types of electronic equipment—and over 140 diagrams and illustrations that make them easy to use.

The ELECTRONIC TECHNICIAN'S HANDBOOK OF TIME-SAVERS AND SHORTCUTS is surely the hardest working partner you could have. It simplifies and speeds up every job you tackle—enables you to get more done, in less time—and, as a result, **SENDS YOUR EARNINGS UP FAST!**

This handbook regularly sells for \$12.95. But you can now get it for just \$1.98. It's our way of introducing you to the Electronics Book Service, the no-risk book club that is currently keeping over 50,000 technicians, trouble shooters and hobbyists informed of the most useful new books in the field of electronics—without ever obligating them to buy a single one!

The ELECTRONIC TECHNICIAN'S HANDBOOK OF TIME-SAVERS AND SHORTCUTS is typical of the practical selections we offer our members. It gives you solid, expert help on all kinds of troubleshooting problems. It shows you how to save time—and money—and work.

- Just look at the kind of help you get:
- Shortcuts for making your work with resistors easy.
- Time-saving techniques for use with capacitors.
- Tested techniques for your work with inductors.
- Work-saving methods for accomplishing more with vacuum tubes.
- Proven techniques for working with solid state devices.
- Key steps to soldering and desoldering.
- Successful wiring methods.
- Guidelines for designing and making printed circuits.
- Time-saving shortcuts for chassis construction.
- Faster ways to select and use test instruments.
- Practical shortcuts in breadboarding.
- Easy-to-use chemicals that bring magical results.
- PLUS HUNDREDS OF OTHER SHORTCUT TROUBLESHOOTING TECHNIQUES.

### Cuts hours of time and toil from your toughest jobs.

Showing you successful ways to solve problems quickly, this handbook cuts the toughest troubleshooting jobs from days to hours. And your other jobs from hours to minutes. It gives you fast, proven techniques—in a concise, straight-to-the-point way.

For example, have you wanted to check a capacitor under working voltages? But couldn't because you didn't have specialized equipment handy? Chapter Two shows you how to do it—with only a VTVM!

Instant answers to hundreds of questions that come up every day.

Now all the technical data you need to know—but can't carry around in your head—will be readily accessible to you. In an instant, you'll have the answers to such questions as:

- How can a tube be identified if the numbers are missing?
- How can a TV set be repaired with an inexpensive probe?
- What is the first and most important step in designing a printed circuit board from a schematic drawing?
- How do you check transistors, rectifiers, scr's, triacs and uni-junctions without elaborate equipment?

#### Lavishly illustrated!

For further aid, you'll have OVER 140 ILLUSTRATIONS AND DIAGRAMS that make these shortcuts easy to learn, easy to use. Like these:

- Simplified methods of reading capacitor values.
- Fast ways of testing electronic components.
- Circuits and diagrams for constructing simple, effective troubleshooting instruments.
- A special troubleshooting table that helps locate faulty parts or circuits—SAVING YOU A WORLD OF TIME.

#### To introduce you to the Electronics Book Service.

Whatever your interest in electronics—whether you're an engineer or technician in industry, the operator of a radio-TV repair service, or a hobbyist—membership in the Electronics Book Service can help advance your career, add to your income, enhance the enjoyment of your hobby.

The Electronics Book Service screens hundreds of books on the subject, selects those which are the most useful and valuable, and reports to you every four weeks on books which can be yours at generous savings. Your membership is an ideal way to keep in touch with the onrushing advances in electronics and its applications.

Remember, the Electronics Book Service has NO MINIMUM PURCHASE REQUIREMENTS, unlike ordinary book clubs. Once you've paid \$1.98 for the ELECTRONIC TECHNICIAN'S HANDBOOK OF TIME-SAVERS AND SHORTCUTS, you don't need to purchase any further selections!

Why delay? Mail the coupon below to get your copy of this \$12.95 handbook for only \$1.98—and to receive all the benefits of membership in the Electronics Book Service on a RISK-FREE trial basis. Fill out and mail your coupon right away.

Here is the practical efficient way in which the ELECTRONICS BOOK SERVICE operates:

1. When you enroll as a member, you receive—for only \$1.98, plus postage and handling with tax where applicable—your copy of the ELECTRONIC TECHNICIAN'S HANDBOOK OF TIME-SAVERS AND SHORTCUTS. This is the only obligation you are committed to make.

2. You are under no obligation to accept any minimum number of selections within any time limit. You can take as many or as few as you wish. And, you may resign at any time with no obligation once you have paid for your copy of the ELECTRONIC TECHNICIAN'S HANDBOOK OF TIME-SAVERS AND SHORTCUTS.

3. On selections you do accept, your membership entitles you to a discount from the publisher's list price. This discount is available to members only and provides you with substantial savings.

4. Every four weeks we'll send you a free bulletin describing the current selection. If you want the selection, no action is required; it will be shipped to you automatically. If you don't want it, just return the card enclosed with the bulletin.

5. You have at least 10 days to decide whether you want the selection or not. Return the card so we receive it no later than the date specified. If you don't have 10 days to answer and receive an unwanted selection, return it at our expense.

6. Each bulletin also describes a number of alternate or additional selections also available to you at the special discount price for members.

### FILL OUT AND MAIL THIS COUPON TODAY.

#### ELECTRONICS BOOK SERVICE

Dept. 6699 M1 (7)  
Englewood Cliffs, New Jersey 07632

Please enroll me in Electronics Book Service on a risk-free trial basis. I am to receive all announcements, free of charge, and will be entitled to full privileges as a Member without obligation to buy any specific number of club selections. As my first selection under this trial membership, send me the ELECTRONIC TECHNICIAN'S HANDBOOK OF TIME-SAVERS AND SHORTCUTS for only \$1.98.

Name \_\_\_\_\_

Address \_\_\_\_\_

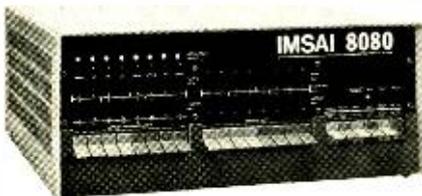
City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

CIRCLE 52 ON FREE INFORMATION CARD

← CIRCLE 100 ON FREE INFORMATION CARD

# The IMSAI 8080.

## A commercial yet personally affordable computer.



If you thought you could never afford a computer at home, think again. The IMSAI 8080 is built for rugged industrial performance. Yet its prices are competitive with Altair's hobbyist kit. Fully assembled, the 8080 is \$931. Unassembled, it's \$599.

The IMSAI 8080 is made for commercial users, and it looks it. Inside and out. The cabinet is attractive, heavy gauge aluminum. The heavy duty lucite front panel has an extra 8 program controlled LED's. It plugs directly into the Mother Board without a wire harness. And rugged commercial grade paddle switches are backed up by reliable debouncing circuits.

The system is optionally expandable to a substantial system with 22 slots in a single printed circuit board. And the durable card cage is made of commercial-grade anodized aluminum.

The IMSAI 8080 power supply produces a true 28 amp current, enough to power a full system. You can expand to a powerful system with 64K of software protectable memory plus an intelligent floppy disk controller. You can add an audio tape cassette input device, a printer plus a video terminal and a teletype. And these peripherals will function with an 8-level priority interrupt system. BASIC software is available in 4K, 8K and 12K.

Get a complete illustrated brochure describing the IMSAI 8080, options, peripherals, software, prices and specifications. Send one dollar to cover handling to IMS. The IMSAI 8080. From the same technology that developed the HYPERCUBE Computer architecture and Intelligent Disk systems.

Dealer inquiries invited.

# IMS

IMS Associates, Inc.  
14860 Wicks Boulevard  
San Leandro, CA 94577  
(415) 483-2093

Dept. RE-10

# KOMPUTER KORNER

JONATHAN A. TITUS, PETER R. RONY AND DAVID G. LARSEN\*

## OOOOPS!

The Komputer Korner that appeared in the July 1976 issue was mistakenly credited to Jonathan A. Titus, Peter R. Rony and David G. Larsen.

We would like to extend our deepest apologies to Tim Barry. He, in fact, actually authored that column.

WHEN DATA IS TRANSMITTED BETWEEN A microcomputer and an input/output device, three actions must simultaneously occur:

1. The microcomputer must select the specific input/output device that will either receive or transmit eight bits of data.
2. The microcomputer must indicate to the specific input/output device when the bidirectional data bus is available for data transmission.
3. The data must be transmitted between the microcomputer and the input/output device in a very short period of time, typically of the order of microseconds.

In preceding columns, we have discussed *accumulator I/O*, in which data is exchanged between the accumulator and an external I/O device. There is a significant disadvantage associated with such an interfacing technique: there exists only a single origin or destination for data. A typical microprocessor chip, such as the Intel 8080, has in addition to the accumulator a variety of internal general-purpose registers that can exchange information with memory. These registers include the B, C, D, H and L registers, each of which is an 8-bit register. From a programming standpoint, it would be very useful to be able to exchange data between any of these registers and any external I/O device. This is the subject of this month's column.

If you desire to exchange data between a general purpose register and an external I/O device, you employ an exciting interfacing technique called *memory I/O* or *memory mapped I/O*. The basic gimmick behind this technique is quite simple: *you treat the input/output device as if it were one or more memory locations*. By doing so, you provide yourself with the opportunity to employ memory instructions in the 8080 microprocessor instruction set. These instructions transfer data between registers and memory locations.

The differences between accumulator I/O and memory I/O can be best understood

\* Mr. Titus is president of Tychon, Inc., a microcomputer consulting firm in Blacksburg, Virginia. Dr. Rony, Department of Chemical Engineering, and Mr. Larsen, Department of Chemistry, are with the Virginia Polytechnic Institute & State University.

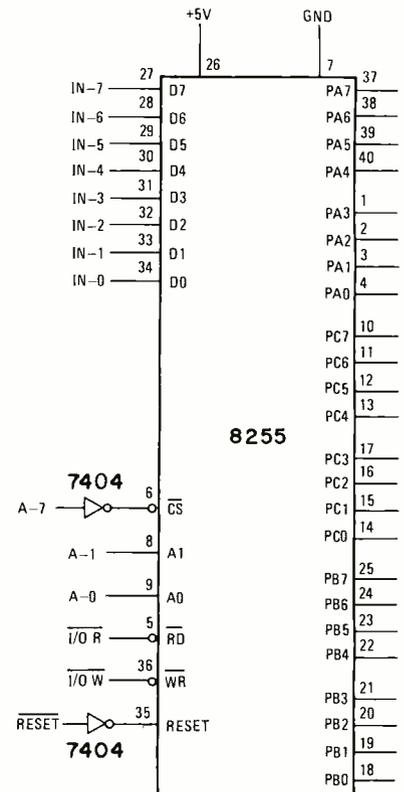


FIG. 1

with the aid of a specific example of an interface between an 8080-based microcomputer and an external I/O device. In this case, the "device" is the Intel 8255 programmable peripheral interface (PPI) integrated circuit. This IC has 24 I/O pins that are shown as PA, PB, and PC in either Fig. 1 or Fig. 2. These pins can be wired directly to any digital device that has TTL-compatible signals.

An 8255 IC appears to an 8-bit microcomputer as either four different external I/O devices or else four different memory locations. Within the IC there are four 8-bit registers that are addressed by the microcomputer:

- Port A—an 8-bit port that can be configured as either an input port, an output port, or a bidirectional I/O port.
- Port B—an 8-bit port that can be configured as either an input or output port.
- Port C—an 8-bit port that can be configured as an input or output port or a pair of control ports—one for port A and the other for port B.
- An internal 8-bit control register that determines the specific I/O

continued on page 24

# The Incredible One-Hander<sup>T.M.</sup>

New Realistic<sup>®</sup> Mobile Radio  
Puts **EVERYTHING** in  
One Hand. *Everything?*  
Yes... **EVERYTHING!**

- Pushbutton Mike!
- Built-In Speaker!
- Illuminated Channel Selector!
- On-Off Switch!
- Volume and Squelch!

It's Patented, Too...  
U.S. Pat. No. 643485

Here's What CB Magazine (May 1976)  
Has to Say About Our "One-Hander"

"On the road, it performed beautifully. The 60 dB of adjacent channel rejection was a particular plus in the test area... In my opinion, this radio is one of the best innovations in mobile communications in many years. Having a lot of the operating controls built into the mike frees the driver from having to reach for the next channel or looking for the volume control while paying attention to traffic."



## Invented by Radio Shack to give you one-hand control for driving safety, amazingly easy operation

A CB "first" — either-hand ONE HAND control of all functions. And the rest of the transceiver is so small you can hide it away under the dash or seat, even in the glovebox. A high-quality, super-convenient radio in every detail. With all crystals for full 23-channel coverage. Built-in blander and ANL to chop out ignition-type noise. Ceramic filter to cut station interference. Positive or negative ground. Jack for optional extra remote speaker. FCC Type Accepted, of course. Adjustable mounting bracket, power cable for any 12VDC vehicle included. Better hurry in for yours — everybody is going to want the One-Hander!  
Ask for 21-161.

149<sup>95\*</sup>

Handset shown  
actual size



The 1½x5¼x7" remote section is easily concealed. 3-way switch for its own built-in speaker, handset speaker, external speaker.



We've put the whole works in ONE hand. Even a red LED that lights up when the set is "on" and indicates the channel number. Coiled cord extends to 5 feet, gives you freedom of movement and lets you place the handset anywhere.

SOLD ONLY WHERE YOU SEE THIS SIGN:

# Radio Shack<sup>®</sup>

A TANDY CORPORATION COMPANY  
OVER 5000 LOCATIONS • 50 STATES • 9 COUNTRIES



Use your credit card  
at most stores

\*Retail Price May Vary at Individual Stores and Dealers.

**FREE!** NEW 1977  
RADIO SHACK CATALOG



AT OUR 4200  
USA STORES AND DEALERS

- Exciting New 56th Anniversary Edition
- Over 2000 Exclusive Products
- Full Color • 164 Pages

CB • Hi-Fi • Radios • Phonos • Recorders • Tape • Antennas  
Kits • Batteries • Parts • Car Stereo • PA • Intercoms • More

CIRCLE 27 ON FREE INFORMATION CARD

configuration of the 8255 IC and can be altered at any time by the microcomputer.

As can be seen in Figs. 1 and 2, the 8255 IC contains, in addition to the three I/O ports, an 8-bit bidirectional data bus (D0 through D7) that communicates directly with the 8080 IC: six control inputs— $\overline{CS}$ , A1, A0,  $\overline{RD}$ ,  $\overline{WR}$ , reset, and two power inputs.

**Accumulator I/O**

In accumulator I/O, you employ the  $\overline{I/O}$  R and  $\overline{I/O}$  W function pulses to read from and write into the 8255 chip.<sup>1</sup> The IC is addressed with the aid of bits A0 through A7 (or A8 through A15) on the 16-bit memory address bus of the 8080 microprocessor. In Fig. 1, we use A7 as the IC-select input and A0 and A1 to select one of the four different registers present within the IC. For example, the following program writes information from the 8080 IC into port A.

323<sub>8</sub> Enable the register for port A and allow it to accept data from the accumulator register

200<sub>8</sub> Device code for port A

The port is treated as an I/O device and an accumulator I/O instruction, 323<sub>8</sub>, is used. A simple change in the control register will turn port A into an input port and permit the use of the program to read information into the 8080 IC from port A.

333<sub>8</sub> Enable the register for port A and allow it to send data

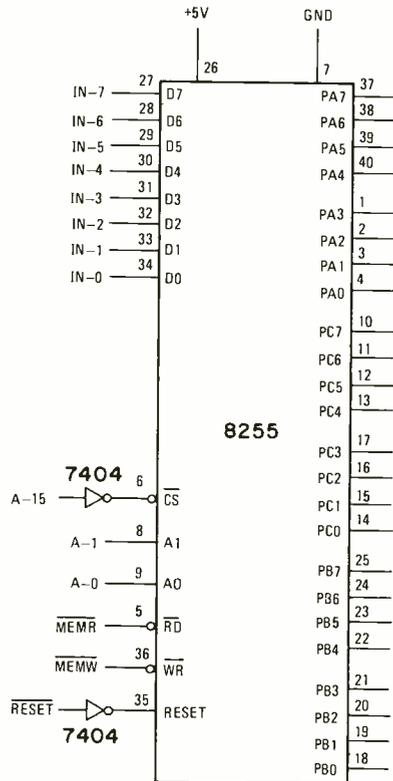


FIG. 2

to the accumulator register  
200<sub>8</sub> Device code for port A

**Memory I/O**

In memory I/O, the  $\overline{MEMR}$  and  $\overline{MEMW}$  memory read/write function pulses are used to exchange data between the internal registers within the 8080 IC and the 8255 registers.<sup>1</sup> The entire 16-bit memory-address bus can be used to address the IC. As shown in Fig. 2, bit A-15 is used as the IC-select input and bits A0 and A1 as the register-select inputs. To output data from register B to port A, the following program can be used:

041<sub>8</sub> Set the 16-bit memory address pointer register within the 8080 microprocessor chip to the memory address of port A  
200<sub>8</sub> Move the contents of register B to port A

Once port A has been selected, you can successively output data from other registers in the 8080 microprocessor:

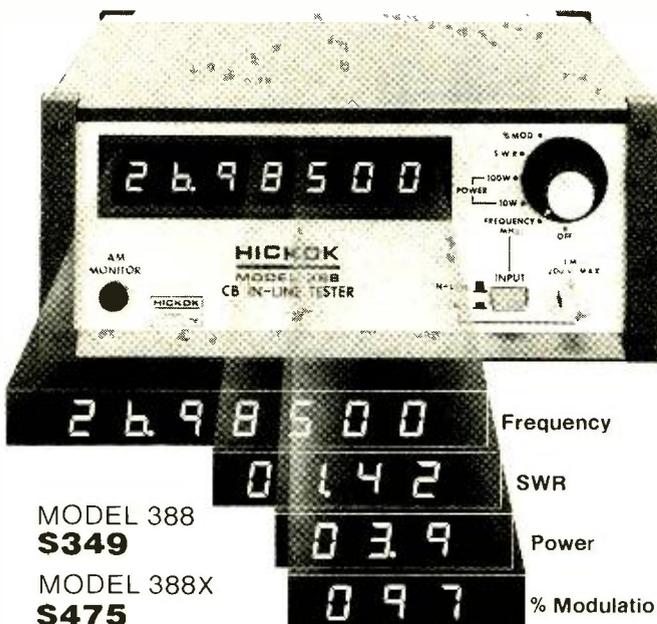
161<sub>8</sub> Move the contents of register C to port A  
162<sub>8</sub> Move the contents of register D to port A  
163<sub>8</sub> Move the contents of register E to port A  
167<sub>8</sub> Move the contents of the accumulator to port A

Each additional transfer of data requires only 2- $\mu$ s execution time, which is quite a bit faster than the 5  $\mu$ s required for successive accumulator I/O data.

We have demonstrated that both the accumulator I/O and the memory I/O techniques are applicable to the 8255 IC. The specific application will determine the best

continued on page 26

# CB testing just became a snap.



MODEL 388  
**\$349**

MODEL 388X  
**\$475**

Hickok Model 388X features a precision temperature compensated crystal oscillator with 1 ppm accuracy.

## Now one unit does it all.

Hook our versatile Model 388 in line with your transmitter and instant digital readouts of a transmitter's four most important operating parameters are a turn of a switch away.

A front-panel AM Monitor Output makes scope display of modulation easy. A pushbutton selects front panel or in-line frequency input. And changing to 12V operation is easy, too.

Get your hands on the new Hickok Model 388 CB In-Line Tester. We're betting you can't let go.

The Hickok Model 388 CB In-Line Tester is one element of the modular Hickok CommLine. To put together the CommLine system that's right for you, talk to your Hickok distributor.

**HICKOK**  
CommLine

**HICKOK**  
the value innovator

INSTRUMENTATION & CONTROLS DIVISION  
THE HICKOK ELECTRICAL INSTRUMENT CO  
10514 Dupont Avenue • Cleveland, Ohio 44108  
(216) 541-8060 • TWX 810-421-8286

# When you install a B-T Booster outside, you get a lot of new boosters inside.

The service technician's job is a tough one. Customers are always grumbling about the high cost of TV service calls. And they complain about poor reception—even when it's almost impossible to get a good signal.

But now and then a TV service technician wins one. And one of the products that can make him a winner, and create customer goodwill, is a Blonder-Tongue outdoor booster.

B-T Boosters can produce a dramatic improvement in picture quality, particularly on color and especially in difficult reception areas. After 25 years of making outdoor boosters, B-T is number one in sales, and enjoys the finest reputation for making

products of highest performance and reliability. B-T Boosters do cost a bit more than competition, but they perform and last longer. And that's what makes satisfied customers.

The VAULTER, for example, is the number one outdoor booster today in the B-T line... *and* in the entire industry. This ultra-high performance, all-channel amplifier offers the ideal combination of lowest possible noise figure (4.6dB, VHF; 7.0dB, UHF) and high gain (15dB). While it can't make unusable, snowy pictures perfect, it *can* reduce fading, loss of color, overcome cable loss and reduce lead-in cable noise. It can even feed more than one TV set from the same antenna in fringe reception areas. It

has separate U/V inputs and a coax output. Finally, it's specially designed for lightning prone areas.

The B-T line consists of 5 all-channel models (including the popular VOYAGER); 5 VHF models and 4 UHF boosters (the ABLE-U2bis is a favorite).

See your B-T distributor for details. And see why you can count on boosters inside, when you install B-T Boosters outside. Blonder-Tongue Laboratories, Inc., One Jake Brown Road, Old Bridge, N.J. 08857.



BLONDER-TONGUE



CIRCLE 4 ON FREE INFORMATION CARD

I/O technique. In some cases, accumulator I/O is best; in others, memory I/O simplifies programming and speeds the transfer of large quantities of data to or from memory. It should be noted that some microprocessors only permit memory I/O interfacing techniques. Such IC's frequently possess special memory addressing instructions that speed execution time for memory I/O addressing.

The principal advantage of the 8255 IC is not in programming or execution time, but rather in the ease of wiring of an interface to an external I/O device such as an analog-to-digital converter, a digital-to-analog converter, a digital panel meter, or a digital multi-

meter. No flip-flops, decoders, or gates are required for the interface; they are all contained within the 8255 IC. In most cases, only SN7404 inverters may be needed to match logic levels between port C, which is usually employed as a control port, and the control pins on the external digital I/O device. It is possible that in the future manufacturers of these semiconductor devices will provide I/O interfaces that will permit a digital instrument to be tied directly to a programmable peripheral interface IC. **R-E**

<sup>1</sup>The accumulator I/O pulse abbreviations, I/O R, I/O W, MEMR, and MEMW are those used by the Intel Corporation, Santa Clara, California. I/O R and I/O W respectively correspond to IN and OUT, which we have used in preceding columns.

# KOMPUTER KORNER 2

TIM BARRY

NOW THAT WE HAVE HAD SOME ARTICLES INTRODUCING the basic 8080 hardware features, we can begin to study its instruction set and programming characteristics. This is the first of three columns in which we will present some of the basic concepts of all computer instruction sets. These concepts will then be illustrated with the 8080 microprocessor.

The instruction sets of all general purpose computers can be broadly divided into four groups:

1. Data Transfer Instructions
2. Arithmetic/Logic Instructions
3. Control Transfer Instructions
4. Processor Control Instructions

Each of these general groups can then be broken down into sub-groups based upon the architecture of the processor being used. This month we will look at the data transfer instructions and their operation.

## Data transfer instructions

Instructions that are used to transfer data from one location in the computer to another without modifying it are all considered to be members of this group. The versatility of a computer's instruction set is directly related to the number of direct data-transfers that can be performed; the more direct data-transfers possible, the easier the computer will be to use.

When analyzing a computer's data transfer instructions, it is useful to think of the entire computer as a collection of *data resources*. A data resource is considered to be any register, memory location, or I/O device. A data resource whose contents can be moved by a data transfer instruction is considered to be a *data source*. A data resource that can receive the data transferred by a data transfer instruction is considered to be a *data destination*. In most computers, any given data resource can be either a data source or a data destination depending upon the instruction being executed. The exception to this occurs with the I/O devices. An I/O device is generally only a data source or a data destination. Thus, an I/O address used for both read and write operations with the same device will probably be communicating with two physically different registers. For example, if you have your teletypewriter hooked up to input port IO and output port IO, input port IO would be the data source and output port IO would be the data destination.

## Data transfer notation

When examining a computer's data transfer instructions, we will use a notation designed to illustrate the action performed by the transfers. These notations are defined here and they will be used from now on whenever we need to illustrate a data transfer.

Notation	Meaning
→	Data transfer
↔	Data exchange
( )	Contents of a data source
[Addr]	Memory location addressed by Addr

continued on page 28

All rooms are not created equal. Nor speakers. Nor albums. Hear what Dyna's truly superior Equalizer can accomplish with your music system. It will astonish perfectionists who have rejected the coloration of other designs. The SE-10 is very probably *the finest sounding equalizer*—certainly at its cost.

It's easier to use, more tolerant, (forget overload, switch pop, and unity gain problems) and has greater versatility. Two separate line in/out pairs, plus tape monitor on one. No inductor saturation, with a hybrid concept utilizing new design IC-simulated inductors at the four low frequencies, and superior performance gapped pot core inductors above 300 Hz, with all polyester control circuit capacitors.

8 ICs, 2 FETs, 5 transistors; IC-regulated power supply; 600 ohm output; typical distortion below 0.01%. Dynakit construction with a single pre-assembled circuit board is fast, easy and fun. Compact Dyna size; optional wood cabinet shown. *Suggested List: Kit—\$249; Assembled \$349*

# unequaled



**dynaco**  
**dynakit**

Write Dept. A-1, Box 28,  
Blackwood, N.J. 08012



CIRCLE 28 ON FREE INFORMATION CARD

# Presenting a picture tube that improves the serviceman's image.

More and more people appreciate knowing exactly what they're getting when they buy a replacement tube.

So carrying a tube with our Gold Seal on it says you're looking at tubes from the customer's point of view.

Which makes you look better to them.

The Sylvania Gold Seal tells your customers that they're getting the finest color tube that Sylvania makes, an All-New AA tube that's backed by a two year (limited) guarantee.\* And, it's

the same tube we make for our own branded and other TV set manufacturers.

The direct benefit to you is that people will probably be willing to spend the extra money for a tube they know they can trust. After all, what name is more respected than Sylvania?

Improving your image with our Gold Seal Replacement tube can help you improve another important image.

Your financial picture.

See your Sylvania distributor for the tubes you need.



**GTE SYLVANIA**

\*Warranted against defects in workmanship, material and construction; labor not included.

([Addr]) Contents of memory location addressed by Addr

The following are some examples of how the above notations would be used and their meaning:

- (A) → B would denote a transfer of the contents of A into B.
- (A) ↔ (B) would denote an exchange of the contents of A and B.
- (A) → [100] would denote a

transfer of the contents of A into memory at location 100.  
([100]) → A would denote a transfer of the contents of memory location 100 into A.

**8080 data resources**

Data transfer instructions in the 8080 may use any of the following data resources as either data sources or data destinations:

1. An 8-bit register (A, B, C, D, E, H, L)
2. A 16-bit register or register pair (BC, DE, HL, PSW, SP, PC)
3. A memory location addressed by a 16-bit immediate address or a

- 16-bit register
- 4. Immediate data
- 5. An I/O device

In the presentation of the 8080 instructions we will use the following notations to represent these data resources:

**Symbol Data resource**

S	An 8-bit register (A, B, C, D, E, H, or L)
M	The contents of memory as addressed by the HL register pair
RP	One of the 16-bit registers BC, DE, HL, or SP
RS	One of the 16-bit registers BC, DE, HL, or PSW, where PSW is composed of A and the processor flags
RD	One of the 16-bit registers BC or DE
Addr	A 16-bit memory address
IO	An 8-bit I/O address
D8	8-bit immediate data
D16	16-bit immediate data

In addition, some instructions will make reference to specific 8080 registers. These will be pointed out as required. All instructions introduced in the following sections will be presented using the standard mnemonics introduced by Intel Corporation when they first released the 8080. The number in parenthesis next to the instruction is the number of bytes of memory occupied by the instruction. Thus MVI D,D8(2) would be the mnemonic representing the two-byte instruction used to transfer an immediate data value consisting of 8 bits into one of the 8-bit destination registers (A, B, C, D, E, H, or L).

**Register to register data transfers**

The first group of data transfer instructions we will consider are those that use internal processor registers as both the data source and data destination. The 8080 allows us to transfer the contents of any 8-bit register into any other 8-bit register. In addition, there are a limited number of transfers that use the 16-bit registers. The following are the register-to-register-data transfer instructions listed by their mnemonics (in bold type), the operation performed in transfer notation and the meaning of the instruction.

**MOV D,S(1)**

Operation performed: (S) → D  
The contents of the source register are transferred into the destination register.

**XCHG(1)**

Operation performed: (HL) ↔ (DE)  
The contents of the HL register are exchanged with the contents of the DE register.

**PCHL(1)**

Operation performed: (HL) → PC  
The contents of the HL register are transferred into the program counter.

**SPHL(1)**

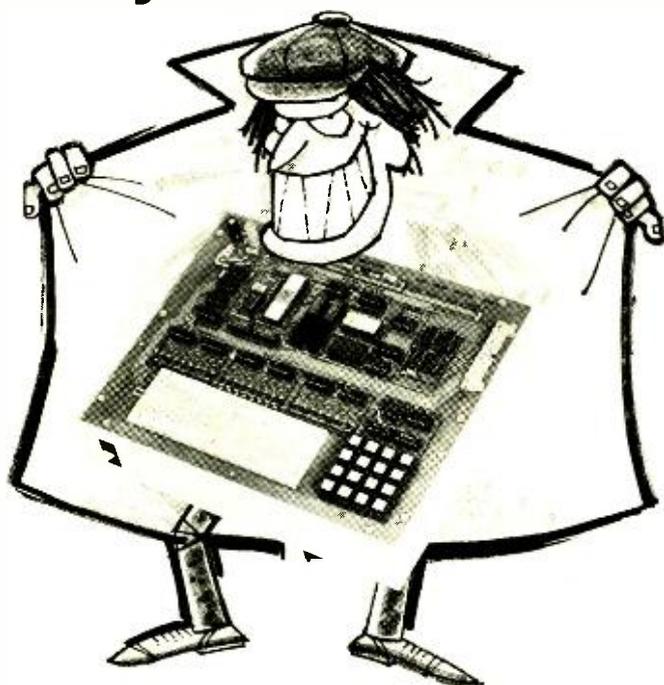
Operation performed: (HL) → SP  
The contents of the HL register are transferred into the stack pointer.

**Memory data transfers**

This class of instruction uses an internal register or register pair as one data source or

continued on page 30

# Without our software, we're just another flasher.



Let's face it. No microcomputer is worth a dime if you can't make it work. Even E&L's Mini-Micro-designer would be just a "light flasher" if it weren't for our software system.

But the fact is that our tutorial software is the best in the business. Not just a pathetic rehash of chip manufacturers' specifications. But a clearly written, step-by-step instruction that teaches you all about the microcomputer. How to program it. How to interface it. How to expand it.

The teaching material is written by Rony/Larsen/Titus (authors of the famous Bugbooks). It's called Bugbook V. And it teaches through experiments designed specifically to get you up to speed on our Mini-Microcomputer (MMD-1). And you don't need any prior knowledge of digital electronics!

The best news? E&L's MMD-1 costs only \$380 in kit form, including all software and teaching material. Send your check or Money Order today (or complete BankAmericard/Master Charge information). We'll pay shipping charges anywhere in continental US.

**CIRCUIT DESIGN, INC.**  
Division of E & L Instruments, P.O. Box 24,  
Shelton, Conn 06484

I believe you. I am ready to order at \$380.00 for the MMD-1 Kit. Enclosed find my Check Money Order or charge information for BankAmericard or Master Charge (Make sure you sign the order blank)

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip Code \_\_\_\_\_

Signature \_\_\_\_\_

Circuit Design will prepay shipping charges anywhere in the US. Contact the factory for additional charges elsewhere

PS If you want an assembled and tested unit order the MMD-1/A at \$540.00

# ONE RIG DOES IT ALL!

Tube and Solid State

THE UNIVERSAL  
**PJS-298**

**33KV LEADED GLASS 19" CRT**

EIA recommended to protect against  
dangerous X-radiation

**A MUST FOR  
TODAY'S  
SERVICING**

**ACCESSORIES INCLUDE:**

- CRT 90° Extension
- Yoke Extension
- Transverter
- Convergence Load
- Universal Yoke
- Convergence Assembly
- Blue Lateral Assembly
- Anode Extension

**SOLD THROUGH DISTRIBUTORS ONLY**

PLEASE SEND ME MORE INFORMATION

Q-6

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_

STATE \_\_\_\_\_

ZIP \_\_\_\_\_



**OBSOLETE PROOF**

Plug in modules for up-dating

**BUILT-IN SPEAKERS**

Easy audio checking

**40 KV METER**

50aU sensitivity monitoring

**FRONT CONNECTORS**

Convenient cable plug-in

~~\$298-98~~ VALUE

**SPECIAL INTRODUCTORY OFFER**

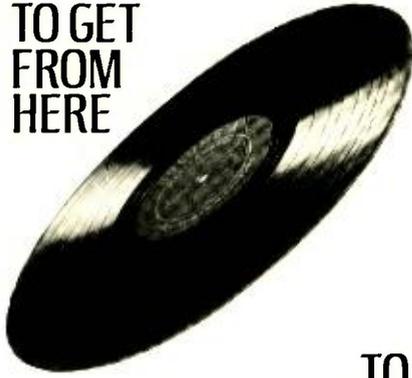
**\$229.95**

COMPLETE WITH CRT

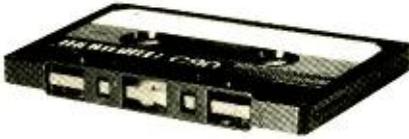
**Telematic**

2849 FULTON ST., BROOKLYN, NY 11207  
PHONE: (212) 827-1500

TO GET  
FROM  
HERE



TO  
THERE



YOU NEED THIS...



Discwasher  
The Superior  
Record Cleaner

 **DISCWASHER INC.**

COLUMBIA, MO.  
CIRCLE 67 ON FREE INFORMATION CARD

## KOMPUTER KORNER

*continued from page 28*

destination and a memory location or locations as the other.

### LDA Addr(3)

Operation performed: ([Addr]) → A  
The contents of memory as addressed by the 16-bit address included with the instruction are transferred into the A register.

### STA Addr(3)

Operation performed: (A) → [Addr]  
The contents of the A register are transferred into the memory location specified by the 16-bit address included with the instruction.

### LHLD Addr(3)

Operation performed: ([Addr]) → L,  
([Addr + 1]) → H  
The contents of memory as addressed by the 16-bit address included with the instruction are transferred into the L register. The contents of memory at Addr + 1 are transferred into the H register.

### SHLD Addr(3)

Operation performed: (L) → [Addr],  
(H) → [Addr]  
The contents of the L register are transferred into the memory location specified by the 16-bit address included with the instruction. The contents of the H register are transferred into memory at Addr + 1.

### MOV D,M(1)

Operation Performed: ([HL]) → D  
The contents of the memory location whose address is specified by the HL register pair is transferred into the destination register.

### MOV M,S(1)

Operation Performed: (S) → [HL]  
The contents of the source register are transferred into the memory location whose address is specified by the HL register pair.

### LDAX RD(1)

Operation Performed: ([RD]) → A  
The contents of the memory location whose address is specified by the register pair is transferred into the A register.

### STAX RD(1)

Operation Performed: (A) → [RD]  
The contents of the A register are transferred into memory at the address specified by the register pair.

### POP RS(1)

Operation Performed: ([SP]) → RS<sub>L</sub>,  
([SP + 1]) → RS<sub>H</sub>,  
(SP) + 2 → SP

The contents of the memory location addressed by the stack pointer are transferred into the low-order register of the register pair (i.e., C, E, L or A). The stack pointer is incremented and the contents of the memory location now addressed are then transferred into the high-order register of the register pair (i.e., B, D, H or Flags). The stack pointer is then incremented again.

### PUSH RS(1)

Operation Performed: (RS<sub>L</sub>) → [SP-1],  
(RS<sub>H</sub>) → [SP-2]  
(SP) - 2 → SP

The stack pointer is decremented by one. The contents of the high-order register of the register pair are then transferred into the memory location whose address is specified by the stack pointer. The stack pointer is then again decremented by one and the contents of the low-order register of the register pair are then transferred into the memory location now addressed by the stack pointer.

### XTHL(1)

Operation Performed: (HL) ↔ ([SP])  
The contents of the HL register pair are exchanged with the contents of the top (last entered) elements in memory as addressed by the stack pointer.

### Immediate data transfers

Immediate data transfers use data that is included with the instruction as the data source and an internal register, register pair or memory location as the data destination. By "included with the instruction", we mean data that is located in the memory location(s) immediately following the instruction. (Using this definition, the addresses included with some of the memory data transfers could be considered to be immediate addresses.)

### MVI D,D8(2)

Operation Performed: D8 → D  
The 8-bit immediate data is transferred into the destination register.

### MVI M,D8(2)

Operation Performed: D8 → [HL]  
The 8-bit immediate data is transferred into memory at the address specified by the HL register pair.

### LXI RP,D16(3)

Operation Performed: D16 → RP  
The 16-bit immediate data is transferred into the selected register pair.

### I/O data transfers

I/O data transfers use input devices addressed by an I/O address as data sources and output devices addressed by I/O addresses as data destinations. As mentioned earlier, most individual I/O devices are either a data source or a data destination.

### IN IO(2)

Operation Performed: (IO) → A  
The data byte supplied by the input device specified by the I/O address is transferred into the A register.

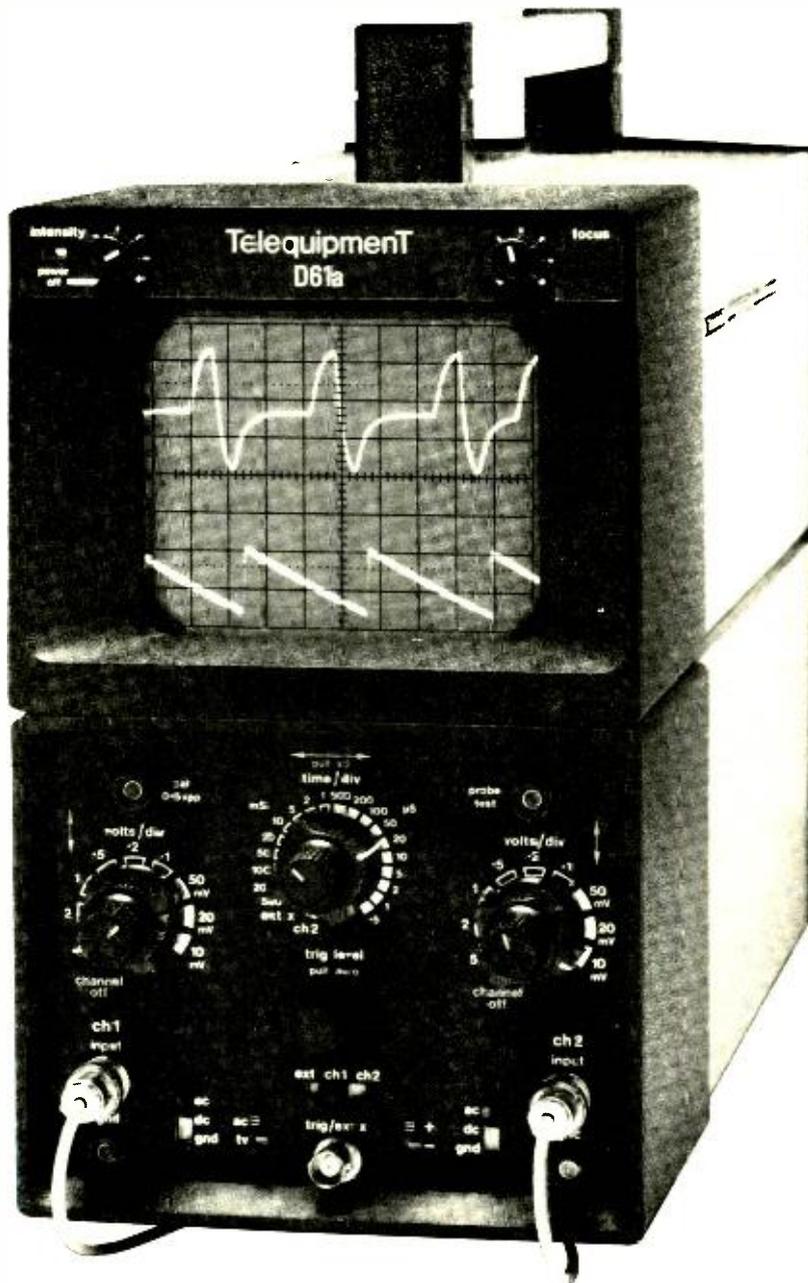
### OUT IO(2)

Operation Performed: (A) → IO  
The contents of the A register are transferred to the output device specified by the I/O address.

### Summary

The 8080 provides a large selection of data-transfer instructions for use in programming (97 unique machine codes). We will use these instructions to maneuver data and addresses around inside the computer.

In the next column in this series we will continue our discussion of instruction sets and the 8080 with a look at the important arithmetic/logic instructions. **R-E**



## A NEW LOW-COST, DUAL-TRACE SERVICE OSCILLOSCOPE FULLY BACKED BY TEKTRONIX

Now for only \$595 you can get a portable, 10 MHz dual-trace service oscilloscope. The 18 lb TELE-EQUIPMENT D61a has front-panel controls that are easy to understand, easy to use. Full-sensitivity X-Y gives you vector displays that are in true phase relationship—displays that you can rely on. And automatic selection of alternate or chopped mode and automatic selection of tv line or frame triggering

make this oscilloscope ideal for classroom use as well as the service shop.

D61a features a bright 8 x 10 cm display, and 10 mV sensitivity in dual-trace and X-Y operation. It is fully backed by a standard Tektronix one-year warranty and may be serviced at any of 50 Tektronix Service Centers nationwide. Call your nearest Tektronix Field Engineer or circle the reader interest

number below for specifications and ordering information on the new D61a and other low cost TELE-EQUIPMENT Oscilloscopes.



P.O. Box 500  
Beaverton, OR 97077

**CIRCLE 49 ON FREE INFORMATION CARD**

# equipment reports

## Hickok 380-Series Frequency Counters

THE HICKOK ELECTRICAL INSTRUMENT CO HAS come out with a new frequency counter. There are actually four models—the 380, 380X, 385 and 385X. The 380 series will read frequencies up to 80 MHz with an accuracy



CIRCLE 83 ON FREE INFORMATION CARD

of 10 parts per million (PPM). The 385 and 385X are basically the same instrument, but will read frequencies up to 512 MHz. These have a built-in prescaler. The 380 and 385 instruments have a crystal oscillator timebase with an accuracy of 10 PPM. The "X" versions of both use a TCXO (Temperature-Controlled Crystal Oscillator) unit, with a stability and accuracy of 1 PPM. Interconnection facilities are provided so that the "plain" versions can be operated from the TCXO of one of the "X" versions. Up to four 380 or 385 counters may be simultaneously operated from the timebase of one "X" unit.

The 380's are all very compact instruments. A 7-digit LED readout is used, visible for quite a distance. These counters are all auto-ranging. All you do is hook it up and turn it on. The input frequency is instantly displayed. The display updates automatically, depending on the frequency. Automatic IC switching in the instrument selects either a 1.0 second or 0.1 second gate-period. This also positions the decimal point so that the reading can be read as either "kHz" or "MHz".

Normally, all frequencies below 10 MHz will be shown in kHz; above 10 MHz, in MHz. If you push the SPEED-READ switch, all frequencies will be read out in MHz.

If you want to, you can use the SPEED-READ button to give automatic gating at 0.1 second at all times. This updates the display a little faster. Actually, this pushbutton is the *only* control on the front panel, aside from the on-off switch! Everything else is done automatically by the IC's.

In the UHF models, the 385's, one more control is added. There are two BNC connectors on the panel. The lower connector is used for frequencies from 1 Hz to 10 MHz, and the upper for frequencies from 10 MHz on up to 512 MHz. The added switch selects the proper input jack. The high-frequency input is then switched to the input of the prescaler, which in turn feeds the basic 380 counter. This is all done with only one special IC and a group of gates.

On both of the basic models (380 and 385), a selector switch on the back panel allows the use of an external timebase. This can be a high-accuracy signal generator or the TCXO oscillator from one of the "X" version instruments. This switch can also be used, without an external timebase, if you want to freeze the display reading for any reason. The instrument will display the last reading until the switch is thrown to INTERNAL again, or the power is turned off.

The display accuracy in all models is  $\pm 1$  count (least significant digit)  $\pm$  the timebase accuracy. Incidentally, the crystal oscillator in the 10-PPM instruments can be calibrated to an accuracy of 0.1 PPM, if a high-accuracy standard signal generator is available.

What can you do with a frequency counter in a service shop beside checking CB transmitter frequencies? Lots of things. For one, you can set any ordinary RF signal generator

*continued on page 34*

## TV Tuner Service Systems

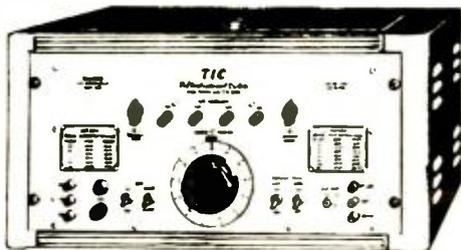
Now you can service and align all TV Tuners . . . VHF & UHF . . . all types.

Provide TV Tuner Service in your area . . . expand into a new professional business.

- Professional TV Tuner Testing Equipment • Laboratory accuracy • Production line durability • Equipment used by the manufacturer in tuner production and test • Furnish high level, accurate signals needed to test, align or analyze TV Tuners.

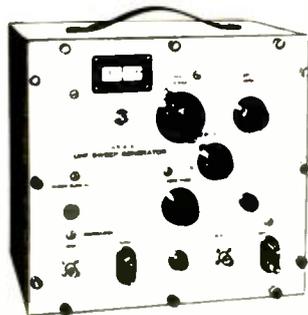
TIC Model 1212 VHF Sweep Generator Sweeps each VHF channel (2-13) with crystal controlled pulse markers for video and sound carriers. Plus 40 MHz i.f. position for Ch #1 (UHF) of tuner or color TV i.f. alignment.

High level output (0.5v). Variable attenuator (80 dB). Inbuilt detector system for Network Analysis. \$400.00



RCA Model WR41B UHF Sweep Generator Tunes the UHF TV band (470-890 MHz). High level output, variable sweep width, built in attenuator (100 dB).

\$285.00



Telonic Model S3 UHF Sweep Generator Tunes the UHF TV band (470-890 MHz). High level output, wide sweep (variable), built in attenuator. \$200.00



Instruments are used, professionally reconditioned, calibrated and guaranteed. Quantities limited

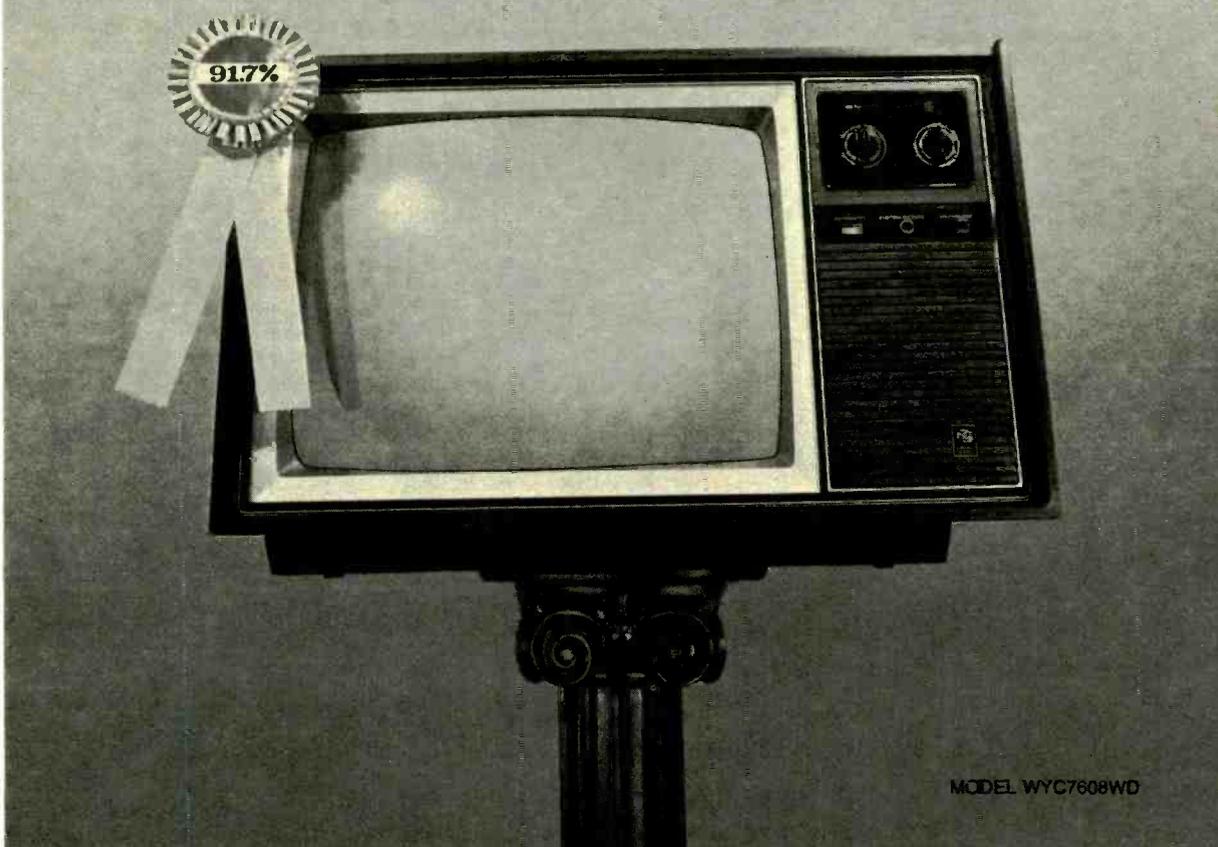
Do not confuse with TV Service type equipment; this is production quality instrumentation, built to operate day in - day out . . . with laboratory accuracy.

Complete TV Tuner Service Systems available, write for details and lists of auxiliary equipment.

WESTERN INSTRUMENTS 5712 N. Western Ave., Chicago, Illinois 60659 (312) 728-1801

CIRCLE 68 ON FREE INFORMATION CARD

# GE 19" diagonal MODULAR Solid State Set gets 91.7% serviceability rating from panel of NESDA members.



This high rating is another example of our continuing commitment to make your business easier.

It's based on a comprehensive checklist of items considered by NESDA (National Electronic Servicing Dealer Association) to be key factors in allowing service technicians to quickly and easily diagnose and repair a TV set.

According to Dick Glass, Executive Vice-President of NESDA, the panel found the overall serviceability of GE's 19" diagonal model WYC7608WD was "excellent".

The YC chassis is modular in design . . . Seven module subassemblies contain approximately 85% of all set components. But, like all General Electric modular chassis, it's designed to be serviced with or without modules. Its swing-away design provides easy access to module components and each module has abundant, clear markings.

*We're making it our business to make your business easier.*

 **performance**  
TELEVISION

GENERAL  ELECTRIC

# PTS TV TUNER TEST INSTRUMENTS... GIVE YOUR CUSTOMERS SERVICE, NOT EXCUSES.



With a PTS analyst you know immediately if a set's tuner is malfunctioning. And if it is, the analyst can replace the defective tuner while it is sent to PTS for repair. No delay, no leaving customers without the use of their set, no excuses. All you have left to give is service.

### PTS TUNER ANALYSTS

Available preassembled or in money saving Do-It-Yourself kits.  
Specify Color: Walnut, Blue or Black. Handles available at no extra cost.

VHF Port-A-Analyst (1010) .....	\$49.95
Kit (1010K) .....	\$43.95
UHF Conversion Kit (UKT-10) .....	\$16.95
All Channel TV Tuner Analyst (2002) .....	\$44.95
Kit (2002K) .....	\$39.95
All Channel Port-A-Tuner (3001) .....	\$49.95
Kit (3001K) .....	\$43.95
All Channel Port-A-Analyst (4001) .....	\$59.95
Kit (4001K) .....	\$49.95
All Channel Field Strength Analyst .....	\$94.50
Not Available in Kit Form	

For more information or to order PTS TV tuner test instruments, contact:



## PTS ELECTRONICS, INC.

P.O. Box 272 Bloomington, IN 47401 812-824-9331

OR, check the white pages for the location of the PTS branch nearest you.

CIRCLE 54 ON FREE INFORMATION CARD



## The Edmund BIOSONE II turns brainwaves into an audible or visual signal. \$149.95 KNOW YOUR ALPHA FROM YOUR THETA!

For greater relaxation, concentration...  
monitor your alpha/theta brainwaves.

Features Normally Found Only In Units Selling For  
More Than \$200.00—And 3 Feedback Modes.

The portable, professional quality Edmund Biosone II boasts 3 feedback modes—LED FM tone, threshold tone; a test mode to check overall system of operation. Easy to use, this beautiful 4-pound, simulated walnut unit (9 1/2 x 5 5/8 x 4 1/4") can be operated at home, in office or clinic. It gives you outputs to allow further monitoring of logic signal, raw EEG, filter output, meter, and FM. Total brainwave monitoring capability, incl. filter select feedback, with wide range calibration sensitivity control (5-100 microvolts). Completely safe, the Edmund Biosone II is similar to an electroencephalograph (EEG), enabling you to identify the electrochemical activity that exists at all times in the human brain. In addition to letting you know when you're most relaxed, Biosone II is a great conversation piece. Included at its low price are a set of electrodes, an earphone jack for private use. Uses latest advances in linear circuitry, runs on two 9v transistor batteries (not included).

STOCK NO. 1668EH ..... Just \$149.95 ppd.  
LOW COST STARTERS' UNIT, No. 71,809EH ..... \$55.00 ppd.

### COMPLETE AND MAIL COUPON NOW

EDMUND SCIENTIFIC CO., 300 Edscorp Bldg., Barrington, N. J. 08007

SEND FREE 164 PAGE CATALOG 'EH' Send me: \_\_\_\_\_ Biosone II Monitor(s).  
 No. 1668EH @ \$149.95 ea. \$ \_\_\_\_\_  
 Charge my  American Exp  BankAmericard  Master Chg.  Starters' Unit(s).  
 No. 71,809EH @ \$55.00 ea. \$ \_\_\_\_\_  
 Service and handling charge \$ \_\_\_\_\_ \$1.00  
 Interbank No. \_\_\_\_\_ Enclosed is  check,  m.o. in amount of \$ \_\_\_\_\_  
 Card No. \_\_\_\_\_ Signature \_\_\_\_\_  
 Expiration Date \_\_\_\_\_ Name \_\_\_\_\_ Please print  
 30-DAY MONEY-BACK GUARANTEE. You must be satisfied or return any purchase in 30 days for full refund. Address \_\_\_\_\_  
 City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

HELPING TO DEVELOP AMERICA'S TECHNOLOGY FOR OVER 30 YEARS.  
CIRCLE 1 ON FREE INFORMATION CARD

www.americanradiohistory.com

## EQUIPMENT REPORTS

continued from page 32

right on the button for aligning a CB receiver. The counter can be left hooked up so that any drift can be detected. You can set the RF generator to any frequency you need for TV sweep alignment. You can check the actual frequency of the 3.579545 crystal oscillator in a color TV set, and on and on. This one can be very handy, as I found while trying to work out a puzzle in the color sync. Turned out that the oscillator crystal could not be brought to the right frequency. A new crystal could, and the case was solved.

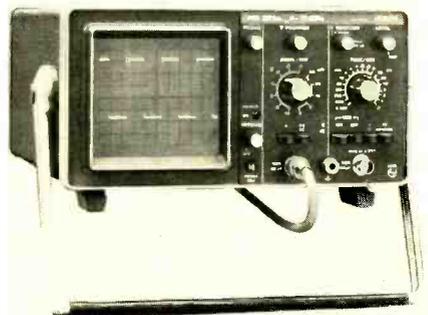
The sensitivity of the 380 series counters is very good. Average, about 25 millivolts for a solid reading. There are upper limits, of course. You shouldn't feed in more than about 40-50 volts, DC plus peak AC, on the medium frequencies, up to about 10 MHz. You can loosely couple the counter input to many circuits and get good readings. For checking radio transmitters, even CB's, a "signal pickoff" and terminating circuit should be used. This takes only a sample of the RF signal voltage, and also terminates the line properly to eliminate standing waves, etc. You will find circuits for these in the instruction manual for the 380 series, complete with parts values. (See: I told you to read the instruction book!)

Another handy use, as suggested by the Hickok, is to play a 1,000 Hz test tape through a player and read the frequency of the output! A 1% error in speed can be detected! It'll read 1.010 kHz!

A nice heavy plastic carrying-case is included with each instrument. This case will hold the counter and all cables, etc.

For more information contact: Hickok Electrical Instrument Co., 10514 Dupont Avenue, Cleveland, OH 44108 **R-E**

## Philips PM3225 Oscilloscope



CIRCLE 84 ON FREE INFORMATION CARD

THE PHILIPS NAME IS WELL-KNOWN IN EUROPE, Asia, Africa and the U.S. Their Test and Measuring Instruments Division has just sent us a sample of their new line. This is the PM3225 oscilloscope. It is a single-channel triggered-sweep scope with a 15-MHz bandwidth and a risetime of 25 nanoseconds.

The sweep can be triggered from the AC line, an external trigger pulse or from either the horizontal or vertical sync pulses of a TV signal. The selection of TV horizontal or vertical trigger is automatic, controlled by the setting of the TIME/DIV selector switch. Incidentally, in our tests the triggering action was

continued on page 36

### GIANT FREE CATALOG!

NEW 164 Pages  
Over 4,500 Un-  
usual Bargains  
for Hobbyists,  
Schools, Industry



JUST CHECK  
COUPON!  
**EDMUND  
SCIENTIFIC CO.**  
300 EDSCORP BUILDING  
Barrington, N. J. 08007  
(609) 547-3488

America's Greatest  
34 Science • Optics • Hobby Mart

# The new Sansui



## The Sansui 9090

# Powerhouse.

Power, features and performance. That's what the new Sansui 9090 and 8080 stereo receivers are all about.

Listen to what the new Sansui 9090 at under \$750.00\* has to offer: • A whopping 110 watts minimum RMS power per channel with both channels driven into 8 ohms over the 20 to 20,000 Hz range with no more than 0.2% total harmonic distortion. • Twin power meters to monitor the output for each channel • Advanced PLL IC Multiplex Demodulator for improved channel separation, eliminating distortion and reducing detuning noise • Twin signal meters for easy, accurate tuning • 7-position tape play switch for total creative versatility in dubbing and monitoring • and many other exciting features. Cabinet finished in walnut veneer.

All in all the Sansui 9090 represents what is probably the most advanced receiver available today. Watt for watt, feature for feature, dollar for dollar, an almost unbelievable value.

Also available is the Sansui 8080 at under \$650.00\* with 80 watts of continuous RMS power under the same conditions with almost all the same features. Cabinet in simulated walnut grain.

Try, and then buy, one of the new Sansui receivers at your favorite Sansui franchised dealer today. You will be glad you did. For years to come.

\*The value shown is for informational purposes only. The actual resale price will be set by the individual Sansui dealer at his option.



Sansui 9090

Sansui 8080

### SANSUI ELECTRONICS CORP.

Woodside, NY 11377 • Gardena, California 90247  
 SANSUI ELECTRIC CO., LTD., Tokyo, Japan  
 SANSUI AUDIO EUROPE S.A., Antwerp, Belgium  
 In Canada: Electronic Distributors

*Sansui*

CIRCLE 30 ON FREE INFORMATION CARD

**EQUIPMENT REPORTS**  
continued from page 34

very solid, holding the most difficult waveforms very steadily.

The horizontal amplifier can be switched to an external input for use with sweep alignment equipment. The sweep can be set from 200 milliseconds-per-division to 0.5 microseconds-per-division in 19 ranges. An expander switch increases the sweep by  $\times 5$  on all ranges. The vertical amplifier has a calibrated attenuator from 10 volts-per-division down to 2.0 millivolts-per-division in 12 steps. The input can be either AC or DC coupled. The amplifiers are all solid-state. The CRT used is a Philips 10-160 (which I think has something to do with the screen size; it is about 160-mm diagonal without measuring it). It's a flat-face type, rectangular, with a P31 (light greenish) phosphor. Both amplifiers have a high impedance input—1 megohm shunted by 25 pf.

Six pushbutton switches on the front-panel select TV or NORMAL triggering, + or - slope trigger, EXTERNAL or INTERNAL trigger, and AC or DC coupling. Last, at the left is a push-push switch marked "O". (Hint for technicians: this does not mean "oh" but "zero"! After some confusion, I finally took the ultimate step and read the instruction manual. This opens the vertical input and grounds it for centering the trace when using the DC coupled input.) The pushbutton switches are big enough so that you can get the one you want without hitting the ones on each side at the same time.

The "human-engineering" of the front

panel is very good. All of the positioning controls and the focus control are at the very top along with the trigger-level control. The intensity control and power switch are down at the lower left corner, leaving the ones we use most often in a clear space in the center. Probes plug-in at the bottom, out of the way.

A set of PM-9326 probes comes with the instrument. This includes a direct probe and a low-capacitance probe with 10:1 attenuation. These have push-on connectors for the coaxial cable, and BNC connectors for the input. Several screw-on tips are included; one fits banana jacks, another is a very short (and very sharp!) needle type and the last is a lightweight spring-loaded hook (retractable) type.

The frequency compensation of the low-capacitance probe is adjusted in a novel way. There is a lock-nut at the back of the probe that is loosened. The probe tip is then touched to the PROBE ADJ terminal on the front panel after pushing both of the EXT and INT trigger buttons at once. This does not display a set of squarewaves; all you'll see will be a single line on the screen. If the line is perfectly straight, the frequency compensation is good. If the left end of the line curves either up or down, just turn the barrel of the probe itself until the line is straight. Now tighten the locknut and the job is over.

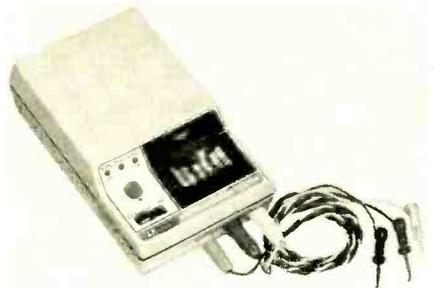
We gave it the regular source of sprouts on the bench. It performed very well holding all of the waveforms that you need to see very solidly. This included my pet toughest, the color bar pattern swept at a vertical rate. Due to the large number of pulses of almost the same height, this one is hard to get hold of.

The TV position of the trigger selector did the job well.

A complete instruction manual is provided, including servicing and a full circuit description as well as full disassembly instructions. The manual is printed in English, French and German; so is the manual on the probe set with the addition of Dutch (nothing unusual, since the original Philips Co. is in the Netherlands). You'll find out that a low-capacitance probe is a verzwakkerkop, which is geschroefd onto the meetkopkabel. Bet you didn't know that; I didn't. Also, be very sure to geschoven de aardkabel on the verzwakkerkop or your ground connection will be left open!

A nice piece of equipment, up to Philips standards which have always been high. I enjoyed using it. Auf wiedersehen, au revoir. **R-E**

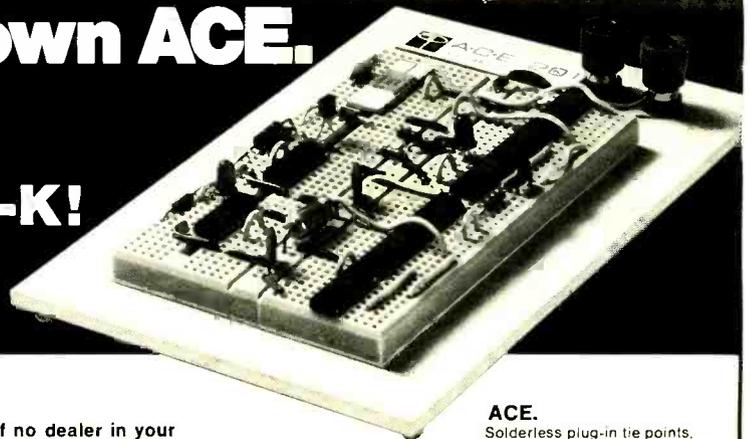
**B & K Precision Model 510 Transistor Tester**



**CIRCLE 85 ON FREE INFORMATION CARD**  
continued on page 38

**Faster and easier costs less when you build your own ACE.**

**SPECIAL OFFER!**  
**\$5 OFF ON ACE 201-K!**  
**NOW ONLY \$19.95**



You know the advantages of ACE, the better solderless breadboards from AP Products. You know that there's no faster or easier way of building, testing, fudging and trying circuits and circuit ideas. But maybe you didn't know that two of our ACEs are available as kits. For people who don't mind taking a few minutes to make faster and easier less expensive as well. And when you order from this ad before November 15th, you can save an extra five dollars on our big 201-K.

If no dealer in your area, order direct.

**ACE.**  
Solderless plug-in tie points, ground plane and binding posts.

Part No.	ACE Model No.	Tie Points	DIP Capacity	No. Buses	No. Posts	Board Size (inches)	Price Each	Qty.	Total
923333	200-K (kit)	728	8 (16g)	2	2	4-9/16 x 5-9/16	\$18.95		
923334	201-K (kit)	1032	12(14s)	2	2	4-9/16 x 7	\$24.95 Special \$19.95		

Credit Card Number \_\_\_\_\_  
4 Numbers Above Name (MC) Good Thru \_\_\_\_\_  
Signature \_\_\_\_\_  
Print Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

- Check or M.O. enclosed
- Charge BAC
- Charge MC
- Send catalog

Total for merchandise	
Sales Tax (OH and CA)	
Shipping (see table)	
<b>TOTAL ENCLOSED</b>	

**Shipping/Handling**  
Up to \$10.00 \$1.00  
10.01 to 25.00 1.50  
25.01 to 50.00 2.00  
50.01 to 100.00 2.50  
100.01 to 200.00 3.00

Orders subject to acceptance at factory.

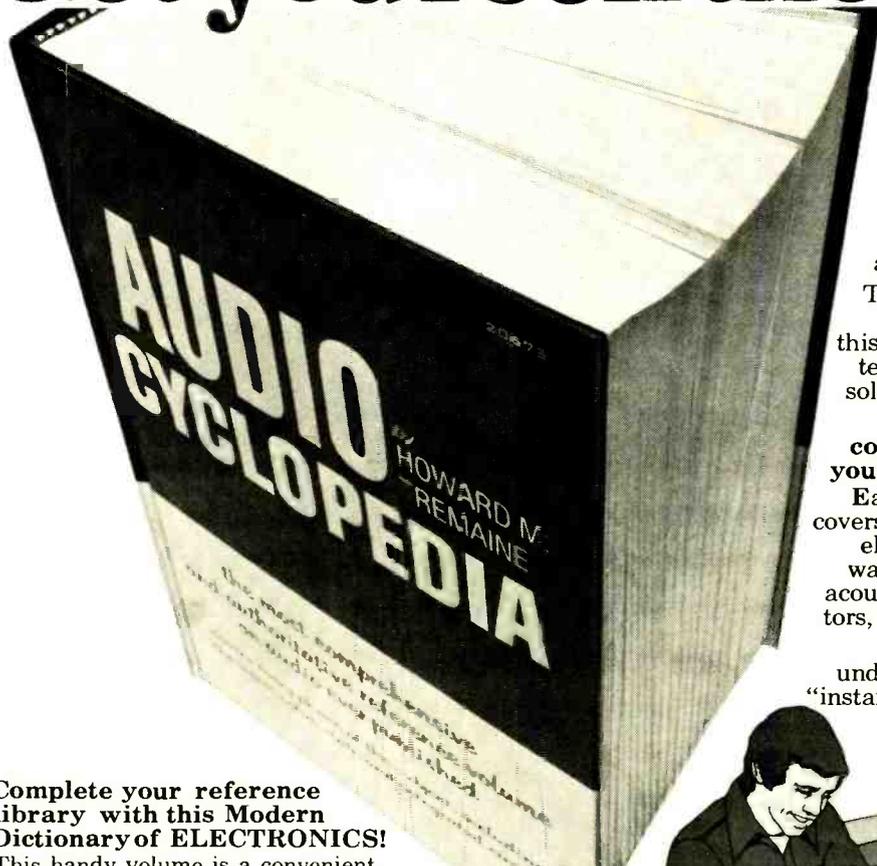
Company PO's FOB Painesville  
No COD orders

**DEALER INQUIRIES INVITED.**



**AP PRODUCTS INCORPORATED**  
Box 110-R Painesville, OH 44077 (216) 354-2101 TWX: 810-425-2250

# Get yourself the big one!



1757 illustrated pages of detailed audio reference for the working technician... the student... the hi-fi buff!

Here's a comprehensive volume especially designed for the man or woman who has an understanding of electronics and an interest in audio technology.

The Audio Cyclopedia is the most authoritative reference book ever published on this subject. It includes every phase of audio technology—plus the latest information on solid-state and integrated circuits.

25 informative chapters... convenient format so you find what you're looking for... quickly... easily!

Each of the big, information-filled chapters covers in depth one of the major areas of audio electronics. You'll find anything you could want to know about everything—amplifiers, acoustics, meters, transformers, coils, transistors, diodes, filters... plus much, much more!

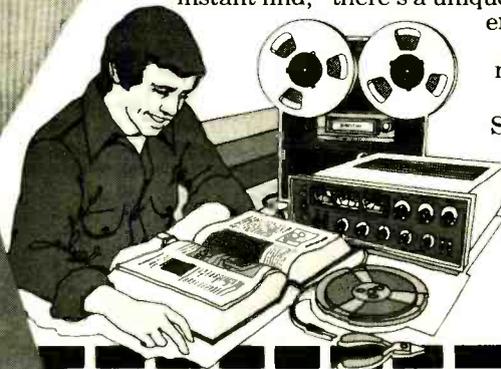
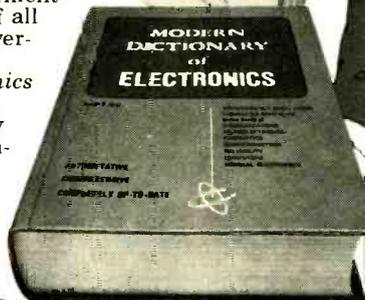
All information is presented in easy-to-understand, question-and-answer format. For "instant find," there's a unique index and reference system so the information you need is always at your fingertips.

Send for this complete reference library today for just \$34<sup>00</sup>

## Complete your reference library with this Modern Dictionary of ELECTRONICS!

This handy volume is a convenient way for you to keep abreast of all the latest happenings in the ever-changing field of electronics. *Modern Dictionary of Electronics* gives you clear, concise definitions of 18,500 terms commonly in use today in the fields of communications, microelectronics, fiberoptics, semiconductors, reliability, computers and medical electronics.

It's yours for only \$14.50



107R1

### MAIL TODAY FOR 15-DAY FREE TRIAL

**YES**—send me the book(s) checked below to examine for 15 days free. If not completely satisfied, I may return my order and owe absolutely nothing. Otherwise, I will pay the amount on the invoice accompanying my book(s), including shipping and handling.

- Audio Cyclopedia** (20675) ..... \$34.00
- Modern Dictionary of Electronics** (20852) ..... \$14.50
- Modern Recording Techniques** (21037) . \$9.95
- Guide to High Fidelity** (21154) ..... \$4.50
- How to Build Speaker Enclosures** (20520) ..... \$4.50

Name \_\_\_\_\_

(PLEASE PRINT)

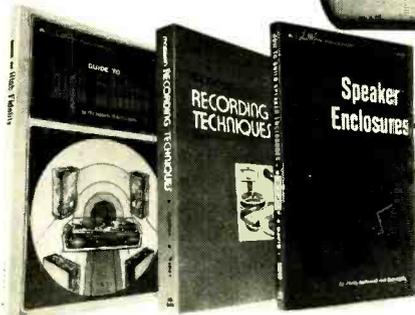
Address \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_ Zip \_\_\_\_\_

Save shipping and handling costs. Full payment enclosed. (Plus sales tax, if any.)

MAIL TO: Howard W. Sams & Co., Inc., 4300 W. 62nd Street  
Indianapolis, Indiana 46206 EC22



For more audio information... Take one or more of these handy paperback guides.

#### Guide to High Fidelity

Here's a convenient guide to help you select a hi-fi system that not only meets your needs but fits your budget besides. If you ever plan to invest in any hi-fi equipment at all, this book is a *must*. Yours for a low \$4.50

#### Modern Recording Techniques

Now, whether you're a would-be recording artist or an experienced engineer, you can find out all about the techniques that are being used today in pop recording. Learn how to cut your own records, and how to use equipment and controls creatively. Just \$9.95

#### How To Build Speaker Enclosures

Here's *the* book to use if you want to build enclosures that give you realistic sound reproduction. Includes directions for enclosures to fit any application... any price range. Yours for a low \$4.50

## EQUIPMENT REPORTS

continued from page 36

THE B & K PRECISION CO., 6460 W. CORTLAND, Chicago, IL 60635 (They've moved!), have come out with a self-contained "pocket" version of their "Dynapeak" transistor tester (fair-sized shirt pocket, that is. In fact, it comes with a neat leatherette case with a belt-loop, so that you could do a "quick-draw" test. With a little practice, you might be the "Fastest Transistor Tester in the West".)

This is their *model 510*. It uses the same digital-pulse test circuitry as the larger industrial tester, the *model 520*. A high-current, low duty-cycle pulse will check transistors in circuits with heavy shunting, down to as low as 10 ohms with the front-panel switch in the HI position, or 1.5K ohms in the LO position. All leads of the transistor will be positively identified in the LO position. Due to the very low duty cycle of the pulses, only 2%, a base-drive pulse of 250 mA can be used in HI position, and only 1.0 mA in LO.

The pulses are developed and detected by digital circuitry. LED indicator lamps identify the transistor as NPN or PNP. A TEST lamp blinks all the time when the tester is on. When this stops blinking, either the NPN or PNP LED will light meaning that the transistor is good. If the transistor is open or shorted, the TEST lamp blinks in all positions of the selector switch.

To test and identify a transistor, just hook up the three color coded test prods in any order. Then, move the 6-position selector switch through the whole range. Color-coded

segments on the front-panel show which leads are connected to base, emitter and collector if the transistor is good.

The 510 comes with three of the most *practical* test prods you ever saw! I was fascinated by the ease with which you can hook them up to any transistor in-circuit, even if only a wee bit of the leads are showing. They have a completely insulated, spring-loaded retractable hook that permits one-hand operation. The hook is only 1.0 millimeter wide. When you let go, the hook is almost completely covered so that even very closely spaced leads will not short to each other. If they have thoughtfully jammed the transistor case right-down to the board, you can still get at it from the underside. The tiny hooks will grab the little pieces of wire left sticking out. So, we don't have to use the "three-handed" method we did with old type test prods.

The model 510 is completely self contained. It comes in a neat carrying case with space to store the test prods inside. Four AA-cells are used. Two very simple tests are given in the manual for checking out the battery and the instrument. All you need is a good general-purpose transistor and two 10-ohm resistors.

Bipolar transistors, FET's and SCR's can be checked in or out of the circuit. When making in-circuit tests in the HI position, you may find that the transistor shows "Good" on two positions of the selector switch. You'll note that this will always be with the same color test lead on the base. This is fully explained in the manual: practically all bipolar transistors will show *some* gain with emitter and collector reversed. This happens

only when the 510 is in HI. Move the selector switch to LO and you should see only one position of the switch with a "good" indication. The transistor leads will then be correctly identified by the colors shown. The manual thoughtfully adds that in rare cases, some very high-frequency transistors may read good in two positions on LO. However, if this happens, the transistor *is* good. As usual with all transistor testers, if a transistor reads bad in-circuit, it should be rechecked after it has been taken out (which we'd have to do anyhow).

Most junction FET's are interchangeable. Drain and source are the same. The 510 will always identify the gate-lead and check the device for quality. To test SCR's out of circuit, use the HI position. A good SCR will indicate PNP in one position and NPN in another, but these two must *not* show the same base-lead color. If the SCR meets these three conditions, it's good. For identification, when the NPN lamp glows, the base-color is the *gate* lead. When the PNP lamp glows, the indicated base color is the *cathode* lead.

Testing for intermittent transistors is easy with this instrument. Hook up the leads. If you get a good indication, you can heat, cool, jar or move the transistor and watch to see if this causes it to read bad.

As is customary, I have found a way to foul it up. If you're testing a new transistor out of circuit with long leads and it reads bad, look the connections over carefully. If two of the leads are touching, it'll indicate bad. Separate the leads.

This is a very compact and very easy to use little instrument, and I'm still amazed by those test clips; they're SO handy! **R-E**

## RANGE EXTENDERS



### FOR YOUR FREQUENCY COUNTER

The RANGE-X™ preselectors will increase the upper frequency limit of your counter ten fold! These preselectors accurately divide all frequencies by ten, enabling your counter to display the resultant frequency.

- HIGH INPUT SENSITIVITY
- INPUT PROTECTION
- RF AMPLIFIER
- TRIGGER LEVEL CONTROL
- UL LISTED POWER SUPPLY

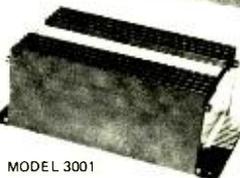
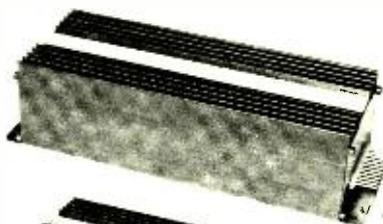
#### THREE MODELS:

FR125X - UP TO 125 MHz - \$59

FR250X - UP TO 250 MHz - \$85

FR500X - UP TO 500 MHz - \$125

MODEL 6000



MODEL 3001

Compatible with all car radios and tape players. Available in kit or assembled versions:

3001 - \$49.50	3001K - \$36.50
4000 - \$47.50	4000K - \$32.50
6000 - \$79.50	6000K - \$49.50

## CAR SOUND SYSTEM COMPONENTS

by Jandy International

Ever wish you could take your home stereo along with you in your car or van?



... NOW YOU CAN!

Would you like more power and less distortion? Two amplifier models offer power to suit any need. The Jandy 6000 gives you a resounding 60 watts RMS\*, while the Jandy 3001 provides a full 30 watts RMS\*.



MODEL 4000

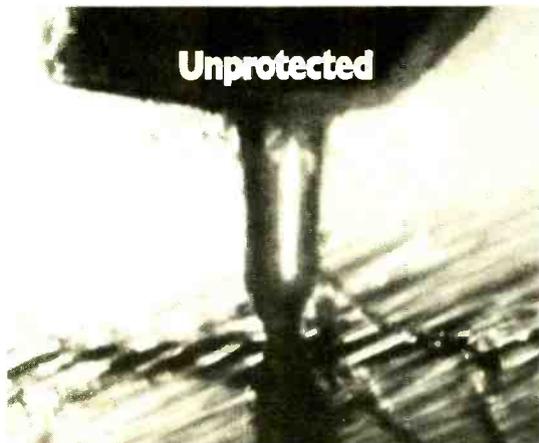
Would you like an equalizer with full range bass, midrange and treble controls, hiss filter, and more? Add the Jandy Control Console 4000 to either amp for the ultimate in car sound systems.

\* Less than 3% THD at 1KHz, 4 ohm load (4 or 8 ohm on 6000)

<b>Jandy International</b>		2001 North Buena Vista Burbank, Calif. 91504	
Name _____		Model No. _____	Price _____
Address _____		<input type="checkbox"/> Check <input type="checkbox"/> MO for \$_____ enclosed <input type="checkbox"/> Bank Americard <input type="checkbox"/> Master Charge*	
City _____ State _____ Zip _____		Acct _____	
Calif. residents add 6% sales tax		*Interbank No. _____ Exp. date _____	
Total _____		X _____ Sign your name as it appears on your charge card.	

CIRCLE 50 ON FREE INFORMATION CARD

# If you can see a difference, imagine what you'll hear.



Magnified, you can see record vinyl wearing away.

With same magnification, record vinyl shows no wear.

You're looking at the solution to one of the oldest problems in audio—how to protect records from wear, while at the same time preserving full fidelity.

It's called Sound Guard,\* and it's remarkable.

Independent tests show that discs treated with Sound

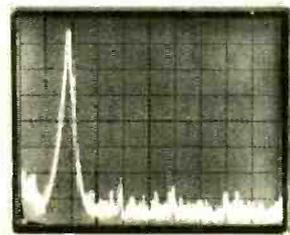
distortion as "mint condition" discs played once.

A by-product of dry lubricants developed for aerospace applications, Sound Guard preservative is so smooth it reduces friction, yet so thin (less than 0.000003") it leaves even the most fragile groove modulations unaffected.

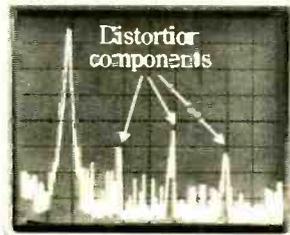
Len Feldman in Radio Electronics reports "At last!

The long awaited record-care product has arrived. It preserves frequency response

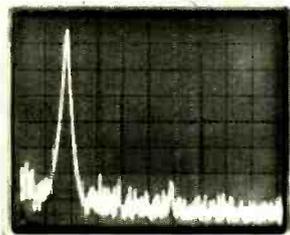
in a kit complete with a non-aerosol pump sprayer and



Test record played first time.



After 100 plays without Sound Guard.



Identical test record after 100 plays with Sound Guard.



Guard preservative played 100 times display the same full amplitude at all frequencies and the same absence of surface noise and harmonic

while reducing distortion and surface noise." It's effective and safe for all discs, from precious old 78's to the newest LP's.

Sound Guard preservative,

velvet buffing pad, is available in audio and record outlets.

## Sound Guard keeps your good sounds sounding good.

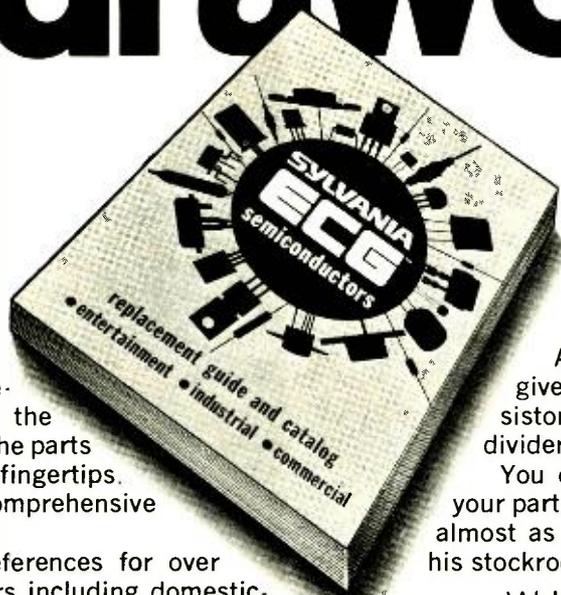


\*Sound Guard is Ball Corporation's trademark for its record preservative. Copyright © Ball Corporation, 1976.

CIRCLE 65 ON FREE INFORMATION CARD

www.americanradiohistory.com

# How to fit 119,000 parts in your desk drawer.



Our 1976 ECG™ Semiconductor Replacement Guide is the compact way to keep the parts you need right at your fingertips.

It's the most comprehensive book in the industry.

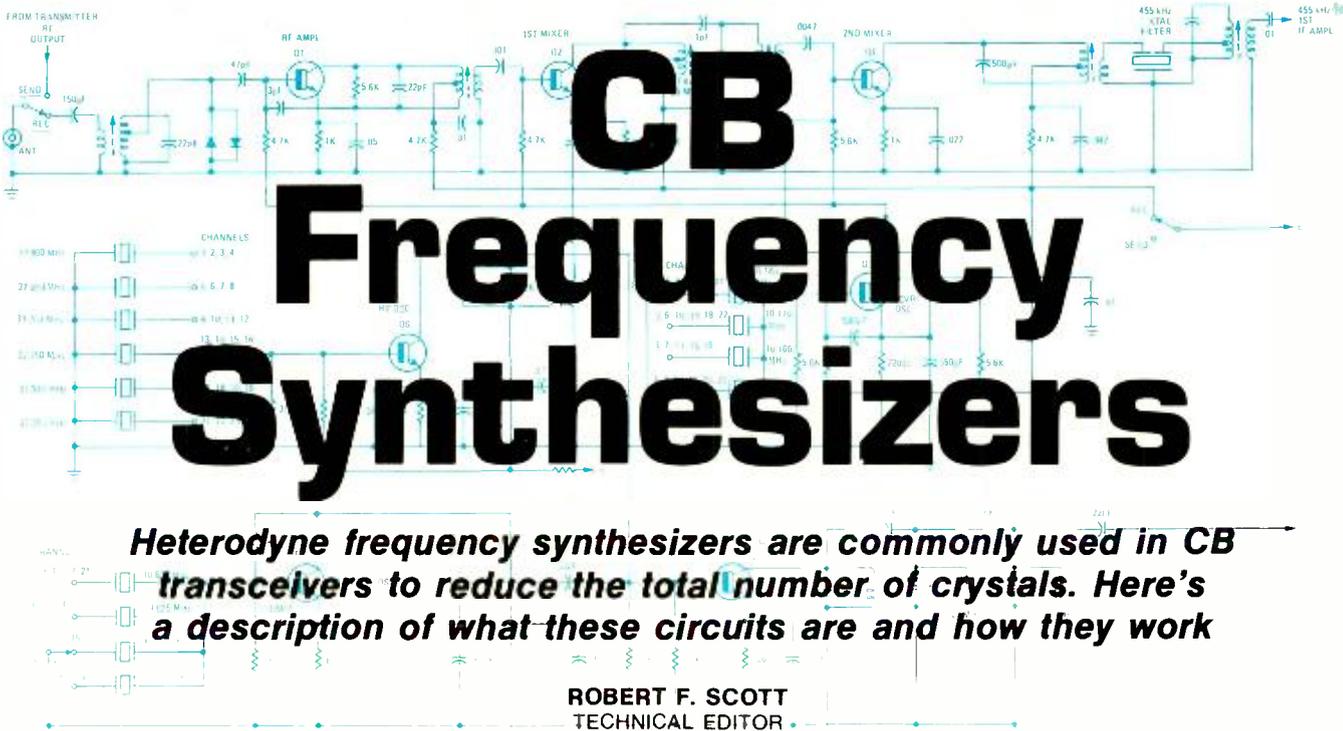
There are cross-references for over 119,000 part numbers including domestic-and-foreign entertainment, commercial and industrial types. Plus a brand new section on CB radio replacements.

An expanded technical data section gives you detailed specs on new transistors, ICs, rectifiers and high-voltage dividers in the ECG line.

You can get your copy where you get your parts—at your Sylvania distributor. It's almost as good as having your own key to his stockroom.

We're helping you make it.

**GTE SYLVANIA**



**Heterodyne frequency synthesizers are commonly used in CB transceivers to reduce the total number of crystals. Here's a description of what these circuits are and how they work**

**ROBERT F. SCOTT**  
TECHNICAL EDITOR

CRYSTAL CONTROL OF THE CB-TRANSCIEVER transmit and receive circuits must be used to insure that the rig meets the frequency precision and stability requirements imposed by the FCC. Nearly all modern transceivers are equipped to operate on all 23 channels so the basic transceiver will require 46 crystals. (Each channel requires a crystal for the transmit circuits and a crystal for the receive circuits.) *Frequency synthesis*—first applied to CB transceivers nearly 14 years ago—permits the circuit designers to use far fewer than the 46 crystals for crystal-controlled reception and transmission on all CB channels.

One method of frequency synthesis uses from ten to twelve crystals in various combinations to develop all the precision frequencies needed by heterodyning. Although the heterodyne method of synthesizing frequencies may save as many as 35 crystals per set; the world-wide shortage of frequency control crystals has led to the development of synthesizers using from *one to three* crystals in a phase-locked loop (PLL) circuit. The PLL approach to frequency synthesis in CB radios will be covered in a future article.

### The heterodyne frequency synthesizer

Some synthesizers use the *sum* frequency developed by two crystal oscillators to generate either the direct transmitter output frequency or the receiver heterodyne oscillator frequency. Other synthesizers use the *difference* frequency developed by the two oscillators to accomplish the same results. Whichever

frequency (the transmitter or receiver oscillator) is developed by the synthesizer, the other frequency is developed by beating the synthesized frequency with the output of a third crystal oscillator.

Three frequency-synthesizer circuits of the heterodyne-type from three manufacturers are typical examples.

#### Kris XL-23

Figure 1 shows the frequency synthesizer and pertinent receiver and transmitter circuits in the Kris *model XL-23* transceiver.

The channel selector switch has been redrawn in simplified operational form. There are three switch-sections. Two select one of four crystals and one selects one of six crystals. For example, S1-a selects the 37.650-MHz crystal for Channels 5 through 8 and the 37.858 crystal for Channels 21, 22 and 23. Similarly, S1-b and S1-c select the 10.635 MHz and 10.180-MHz crystals, respectively when the radio is operated on Channels 1, 5, 9, 13, 17 and 21.

Let's imagine the transceiver is set on

Channel 19 (27.185 MHz) and see how the transmitter output and receiver heterodyne oscillator frequencies are generated. The high-frequency oscillator (Q6) generates a 37.800-MHz signal and feeds it to the base of mixer Q14 where it is combined with the 10.615-MHz output of the transmit oscillator. Both the sum and difference frequencies are generated in Q14's collector circuit but only the difference frequency ( $37.800 - 10.615 = 27.185$ ) is passed by the three 27-MHz cascaded tuned-circuits. This low-level signal is amplified and modulated and fed to the antenna.

The receiver uses dual-conversion superheterodyne circuitry with the first IF around 10.5 MHz and the second IF at precisely 455 kHz. The incoming 27.185-MHz Channel-19 signal is amplified in Q1 and then fed the Q2 (the first mixer) where it is combined with the 37.800-MHz output of oscillator Q6. The 10.615-MHz difference frequency ( $37.800 - 27.185 = 10.615$ ) is fed to the second mixer where it is heterodyned with the 10.160-MHz output of receiver oscillator Q7. The resulting 455-kHz difference frequency is fed through a crystal filter to the IF amplifier circuits.

To get the hang of how this particular synthesizer scheme works, get a pencil and paper and work out the transmitter and receiver oscillator frequencies for some of the other channels. A table listing the CB channel frequencies is included to help you along.

#### How E. F. Johnson does it

Figure 2 shows the synthesizer and



KRIS *model XL-23*

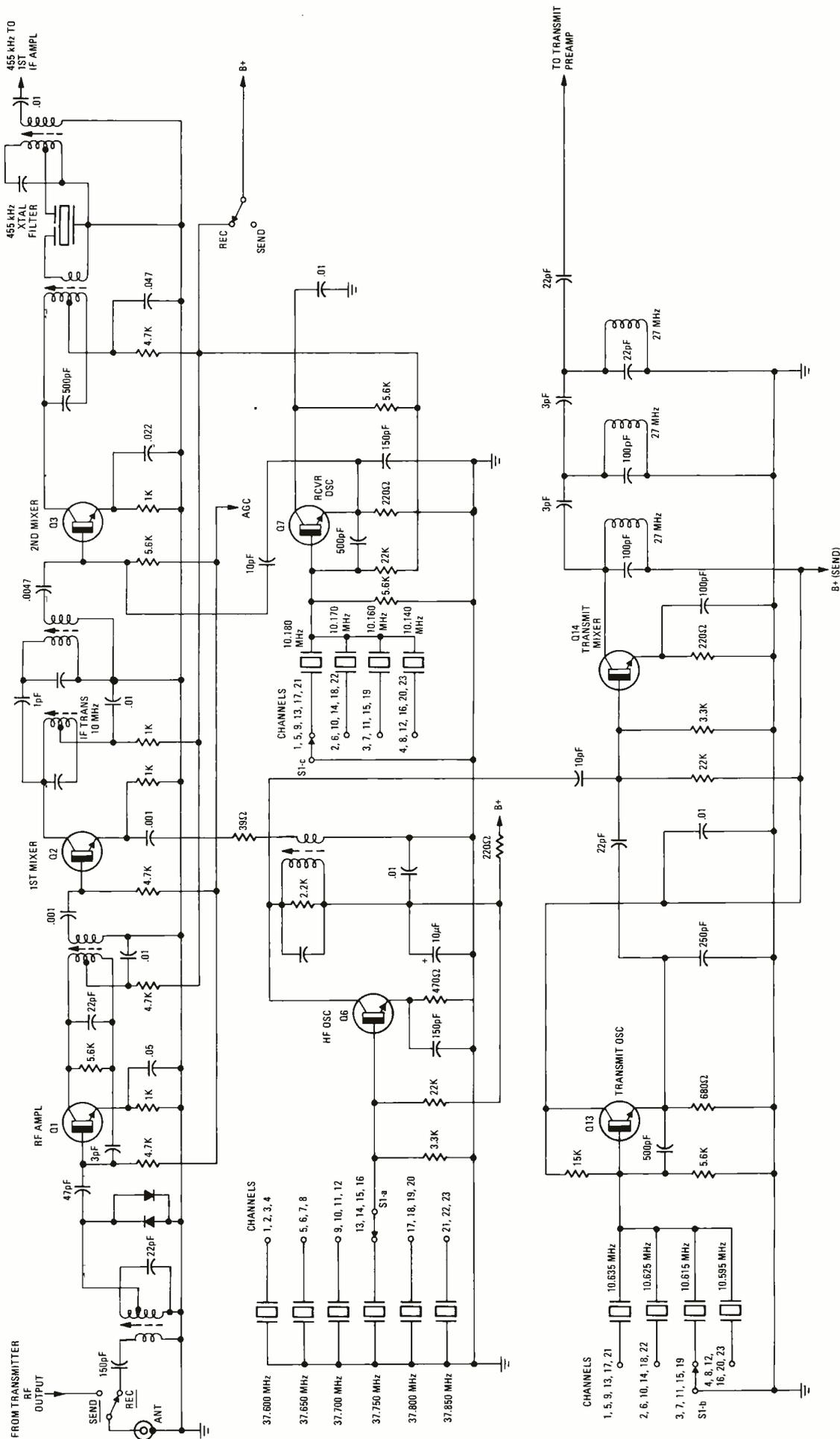


FIG. 1—FREQUENCY SYNTHESIZER and pertinent receiver and transmitter circuits in the KRIS model XL-23 CB transceiver.

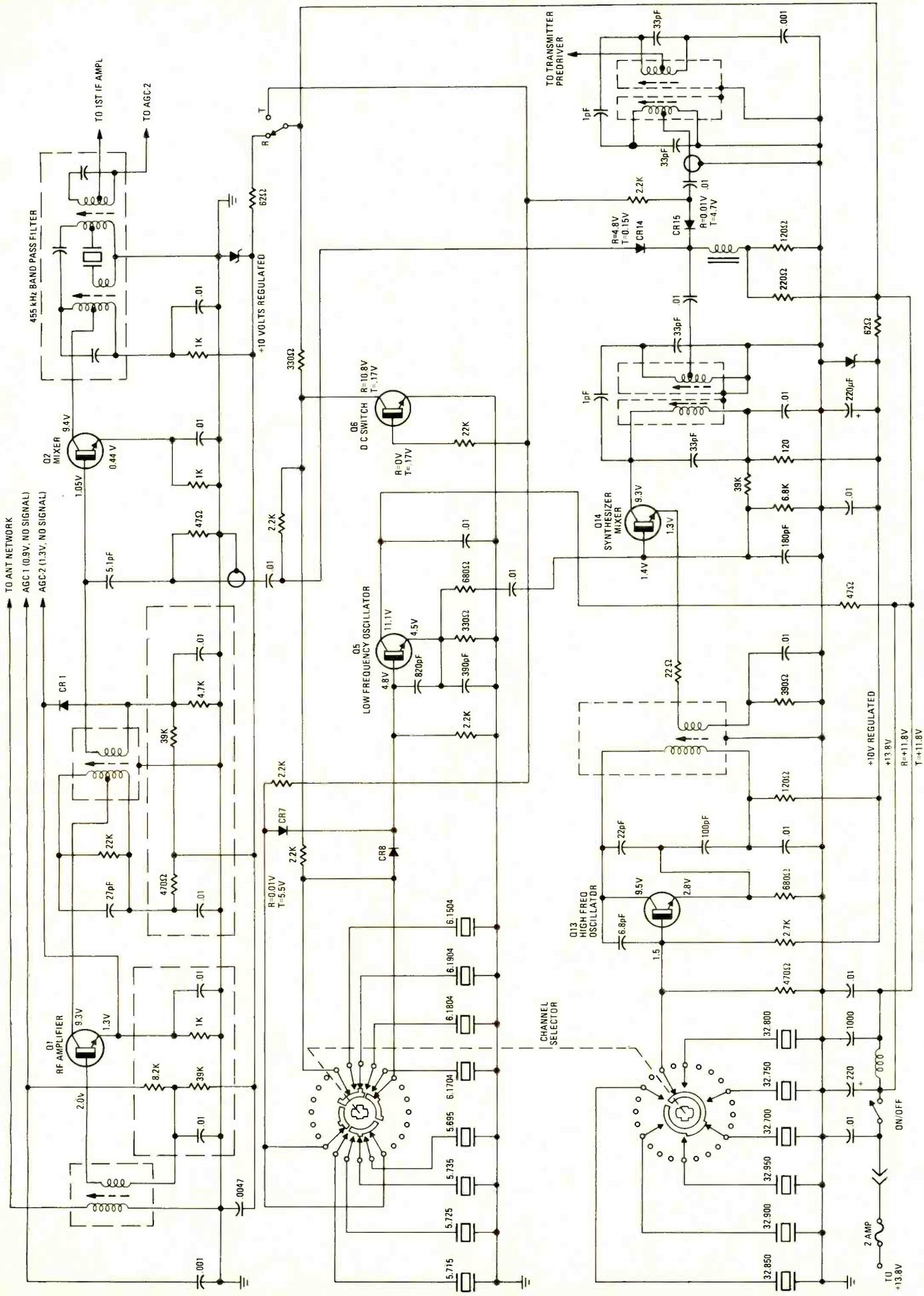


FIG. 2—FREQUENCY SYNTHESIZER consists of a high-frequency oscillator with a bank of six crystals and a low-frequency oscillator with two banks of four crystals each in the E. F. Johnson models Messenger 122 and 123-A.

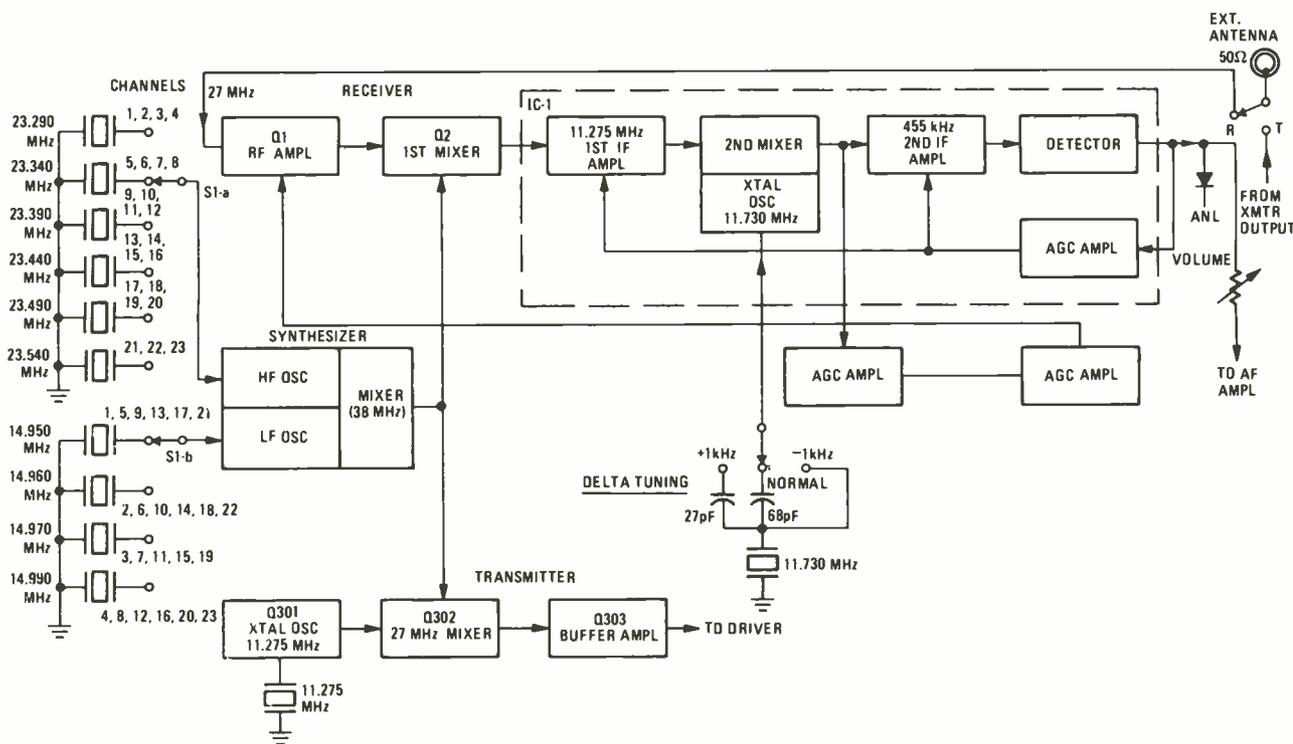


FIG. 3—RECEIVER AND TRANSMITTER RF circuits of the Sharp model CB-800 CB transceiver.

pertinent circuitry used in the *Messenger 122, 123-A* and similar models. The frequency synthesizer consists of a high-frequency oscillator with a bank of six crystals and a low-frequency oscillator with two banks of four crystals each.



E. F. JOHNSON *Messenger 123-A*.

Diodes CR7 and CR8 form a solid-state single-pole double-throw switch. When the transceiver is in the receive mode, CR7 is blocked and CR8 is forward-biased so the selected 6-MHz crystal is connected to the low-frequency oscillator. When transmitting, CR8 is blocked and CR7 is forward-biased to connect the selected 5-MHz crystal to the low-frequency oscillator.

Let's again use Channel 19 as our example to see how this synthesizer works. The high-frequency oscillator operates at 32.900 MHz. The low-frequency oscillator operates at 6.1704 MHz when receiving and 5.715 MHz when transmitting. The high- and low-frequency oscillator signals are fed to the emitter and base, respectively, of the synthesizer mixer.

The bandpass circuit in the mixer output selects the *difference* frequencies in the range of 25.510 MHz (455 kHz below the Channel 1 frequency) to 27.255 MHz (the output frequency of Channel 23). The output of the band-

pass network goes to a second solid-state switch consisting of CR14 and CR15. (CR14 feeds the synthesizer output to the receiver mixer in the receive mode while CR15 conducts to pass the synthesizer output to the transmitter RF amplifier circuits when in the transmit mode.)

When the transceiver is in the transmit mode, the synthesizer mixer's 27.185-MHz output ( $32.900 - 5.715 = 27.185$ ) is fed through forward-biased CR15 to a second bandpass network to the input to the transmitter pre-driver. This signal cannot feed into the receiver's mixer because it is blocked by back-biased CR14.

In the receive mode, the 26.7296-MHz synthesizer output ( $32.900 - 6.1704 = 26.7296$ ) goes through forward-biased diode CR14 to the receiver mixer. In this stage, the difference frequency generated by mixing the incoming 27.185-MHz signal and the synthesizer output is 455.4 kHz. This signal goes through a crystal filter to the 455-kHz IF amplifier circuits.

### The Sharp variation

The Sharp *model CB-800* uses frequency synthesis and includes an LED digital channel indicator and other interesting circuit innovations that we hope to take a look at in another article. Now, let's look at Fig. 3—a functional block diagram of the receiver and transmitter RF circuits.

The output of the synthesizer in this circuit is 11.275 MHz *above* the channel frequency and is used as the injection frequency for the first mixer in the receiver. The resulting difference fre-



SHARP *model CB-800*

### CB CHANNEL NUMBERS AND FREQUENCIES

Chan- nel	Fre- quency (MHz)	Chan- nel	Fre- quency (MHz)
1	26.965	13	27.115
2	26.975	14	27.125
3	26.985	15	27.135
4	27.005	16	27.155
5	27.015	17	27.165
6	27.025	18	27.175
7	27.035	19	27.185
8	27.055	20	27.205
9	27.065	21	27.215
10	27.075	22	27.225
11	27.085	23	27.255
12	27.105		

quency (11.275 MHz) is used as the first IF in the dual-conversion superhet. A second mixer and 11.730-MHz crystal oscillator develop the 455-kHz second IF signal.

When transmitting, the synthesizer mixer and a 11.275-MHz crystal oscillator feed signals into a 27-MHz mixer that generates difference frequencies on page 112

*continued on page 112*

# BUILD FOR YOUR CAR

# Over-Speed Alarms

*The versatile CD4001 IC is the heart of these practical over-speed alarm circuits that you can build and connect to any vehicle with a 6- or 12-volt electrical system*

R. M. MARSTON

IN THE APRIL 1976 ISSUE, WE SAW HOW a single CD4001 COS/MOS digital IC can be used to make an inexpensive but highly efficient precision tachometer or RPM meter. In this concluding part of the story we show how additional CD4001's can be used to expand the basic tachometer circuit so that it also acts as a red-line or over-speed alarm system, which activates an audio/visual alarm when the engine or vehicle speed exceeds a pre-set limit. This alarm system can be fitted to any gasoline-powered vehicle having a 12-volt electrical system.

## The red-line alarm

Fig. 1 is a block diagram of the red-line or over-speed alarm circuit, and Fig. 2 shows its relevant waveforms at low and high engine speeds. The circuit comprises three main sections. These are the red-line or over-speed detector, an alarm-pulse conditioner, and an alarm-condition response unit.

The input signal to the unit is taken from the vehicles ignition breaker points. This signal is passed through an input conditioner circuit, and is then used to trigger monostable multivibrator 'A', so that a pulse of fixed amplitude and duration is generated each time the points open. This monostable has two outputs, one normally-high and the other normally-low (see Fig. 2). The normally-high output feeds a 1-mA moving-coil meter or RPM indicator, in the same way as the tachometer circuit described last month, and is also used to trigger monostable multivibrator 'B': The normally-low output of monostable 'A' is fed to one of the two inputs of a diode AND gate. Monostable multivibrator

output of monostable 'A' triggers high for a pre-set period at the moment that the points first open, and the normally-low output of monostable 'B' triggers high for a pre-set period at the moment that the 'A' monostable pulse terminates. The output of the AND gate is normally low, and goes high only if both of its inputs are high at the same moment.

Suppose, then, that the engine speed is "low", or below the red-line level. Under this condition the repetitive periods of the circuit's input trigger pulses (derived from the vehicle's breaker points) are long relative to the sum of the two monostable pulse periods, so one or other of the inputs to the AND gate are low at all times, and the gate gives zero output. The alarm is inoperative under this condition.

Suppose, on the other hand, that the engine speed is "high", or slightly above the red-line level, and that under this condition the repetition periods of the input trigger pulses equal 9.9 ms, and each monostable generates a pulse with a duration of 5 ms, thus giving a total pulse period of 10 ms.

Under this condition the 'A' monostable fires as soon as a trigger pulse is generated by the breaker points: 5 ms later the 'A' monostable pulse

'B' has a single normally-low output, which is fed to the remaining input of the diode AND gate.

The action of the monostable multivibrators is such that the normally-low

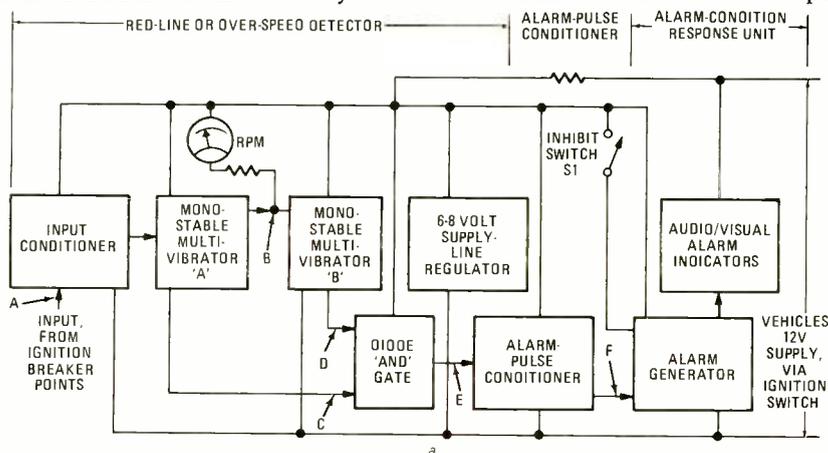


FIG. 1—RED-LINE or over-speed alarm system.

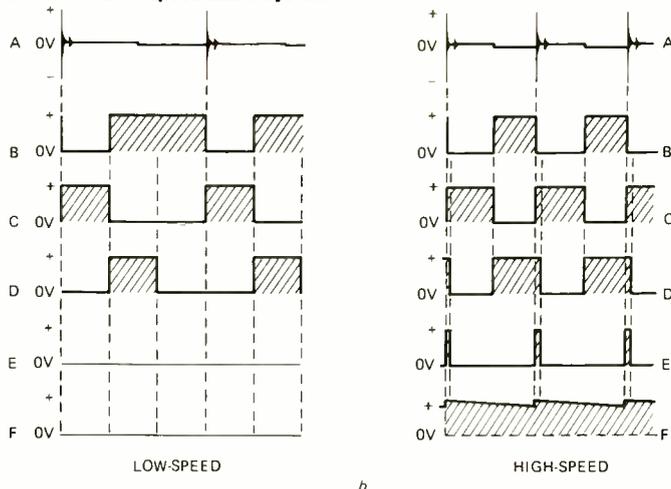


FIG. 2—WAVEFORMS of the circuit. A—Waveform of action at the breaker points. B—Intervals between triggering pulses. C—High outputs of monostable 'A'. D—High outputs of monostable 'B'. E—The pulses due to overlapping of 'A' and 'B'.

terminates, and the 'B' monostable triggers on: 4.9 ms later the 'A' monostable is again turned on by the input signal, and 0.1 ms later the 'B' monostable pulse terminates at the completion of its 5 ms period. Thus, a period of 0.1 ms occurs during each 9.9 ms switching cycle in which both inputs to the AND gate are high at the same time, so a 0.1 ms "alarm-condition" pulse is generated at point E of the circuit. This alarm-condition pulse is fed to a simple peak-reading "conditioner" circuit, and is then used to activate an audio/visual alarm-condition indicator.

Thus, the alarm can be made to activate at any pre-set engine speed by simply adjusting the total period of the two monostable pulses so that they are fractionally greater than the period of the signal derived from the breaker points at the desired RPM value. In practice, the alarm system is very accurate and sensitive, and will reliably respond to changes in engine speed of less than 0.5%.

If required, the basic circuit can be used as a vehicle over-speed alarm, which activates when the vehicle speed exceeds a pre-set limit. This operation is possible (on vehicles with manual-change gear boxes) because of the fixed ratio between engine and road speeds, so RPM is directly proportional to vehicle speed under normal driving conditions. Vehicles usually exceed regulation speed limits only when they are in top (high) gear, so the circuit can be fitted with an inhibit switch, which is open in top gear only, and the alarm can then be pre-set to activate at a RPM value corresponding to the desired road speed in

top gear. A multi-position switch can be fitted to the circuit, if desired, so that a number of pre-set over-speed alarm settings are available.

### A practical over-speed alarm

The practical circuit of a complete red-line or over-speed alarm is shown in Fig. 3-a. Here, the input signal is picked up from the vehicle's breaker points via R1, and is shaped into a neat trigger pulse by Q1 and its associated circuitry. The resultant pulse is used to trigger the IC1 'A' monostable via R6, and the monostable pulse is fed to a 1-mA moving-coil RPM meter via R8. Up to this point the circuit is identical to the tachometer circuit described last month, except that R8 is increased to 5.6K.

The output of the 'A' monostable, taken from pin 11 of IC1, is used to fire monostable 'B', which is designed around IC2. Part of the output of monostable 'A' is also fed to the D5-D6-R10 diode AND gate via a spare inverter-connected gate of IC1, and the output of the 'B' monostable is taken to the AND gate via a non-inverting pulse amplifier stage made up from two spare gates of IC2.

The output of the AND gate is fed to a simple peak-detecting "alarm-pulse conditioner" circuit comprising D7-C4-R11 and R12, and the output of the conditioner is fed to an alarm-condition response unit which gives an audio/visual alarm output and is designed around IC3 and Q2. The response unit operates as follows:

Gates A and B of IC3 are wired as a gated 1.5-kHz astable multivibrator or square-wave generator, and the output of the astable is taken to the base

of Q2 via gate-C of IC3. Q2 uses a speaker, an LED, and current-limiting resistors R16 and R17 as its collector load. The action of the astable is such that it is disabled when pin 12 of IC3 is high, and is operative when pin 12 is low. The input to pin 12 is taken from the output of the alarm-pulse conditioner circuit via inverter-connected gate-D of IC3. Consequently, the astable can be enabled by a "high" output from the conditioner network, but can be disabled by a "low" output from the conditioner or by the closure of INHIBIT switch S1.

Thus, at low engine speeds the output of the conditioner is low, so the alarm-condition response circuit is disabled and Q2 is cut off. At high engine speeds, on the other hand, the output of the conditioner is high, and pin 3 of IC3 is driven to zero volts: If INHIBIT switch S1 is closed under this condition, the response unit remains disabled, but if S1 is open the response unit is enabled and Q2 pulses on and off at 1.5 kHz, so the LED illuminates and a 1.5-kHz tone is generated in the speaker: An audio/visual alarm output is thus given under this condition.

Note that the supply lines to the major parts of the Fig. 3-a circuit are stabilized at 6.8 volts via R18, D8 and C6, and that the circuit can be used on any vehicles fitted with 12-volt positive- or negative-ground electrical systems.

Also note that the Fig. 3-a circuit is shown as having only a single "alarm condition" setting, as would be the case in RPM red-line applications. If required, a multi-position RANGE switch can be fitted to the cir-

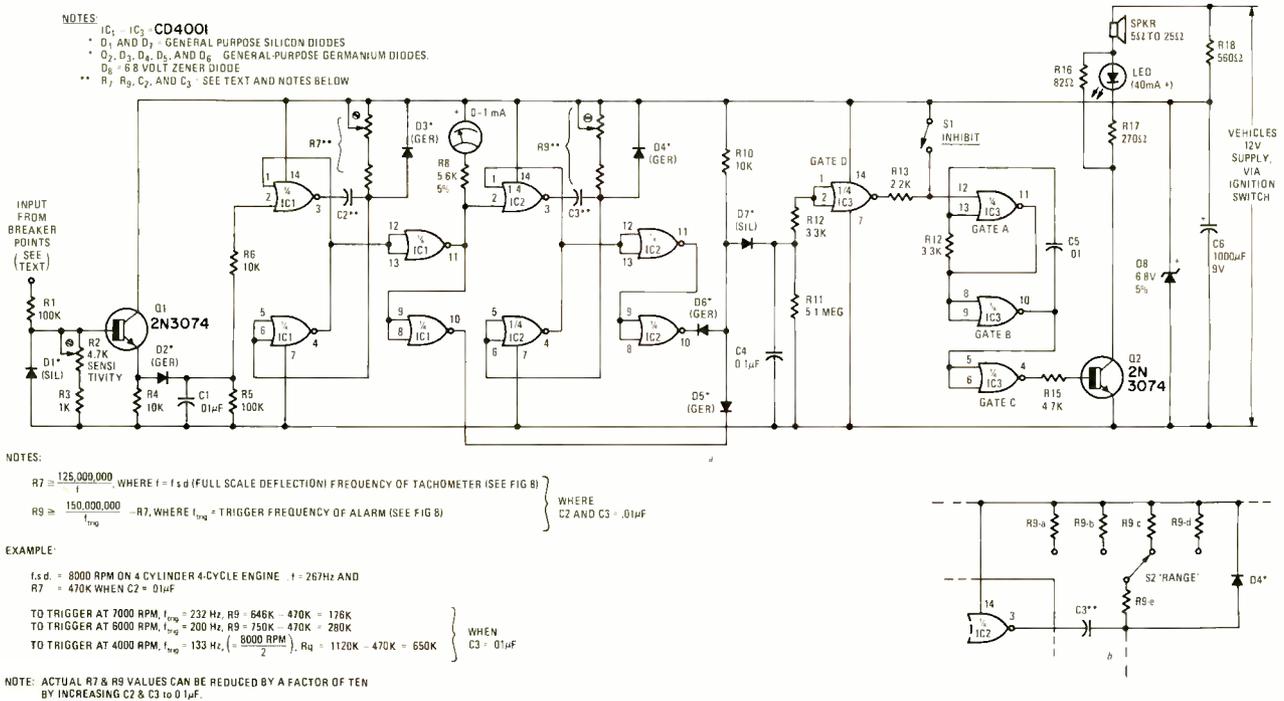


FIG. 3—COMPLETE TACHOMETER and over-speed circuit is shown in a. Modification for multirange indication is shown in b.

cuit, as shown in Fig. 3-b, so that the alarm can be made to activate at a number of pre-set RPM values which correspond to top-gear road speeds, as in the case of vehicle over-speed applications: In this case INHIBIT switch S1 can take the form of a microswitch that is automatically opened in top gear only.

If desired, the moving-coil RPM indicator of the Fig. 3-a circuit can be replaced by a short-circuit, so that the design is used simply as a red-line or over-speed alarm, without the tachometer facility.

#### A "slave" alarm output stage

A simple extra facility that can be added to the basic Fig. 3-a circuit is a slave alarm output, which operates a 12-volt lamp or relay when the main alarm activates. The circuit of this device is shown in Fig. 4.

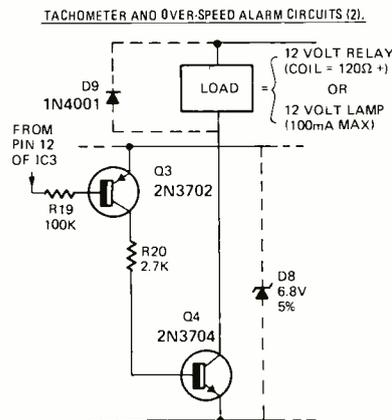


FIG. 4—OPTIONAL SLAVE ALARM.

Here, the relay or lamp is used as the collector load of Q4, which has its base current derived from the collector of Q3. The base current of Q3 is derived from the pin-12 signal of IC3 via R19. Normally, pin 12 of IC3 is at the full 6.8-volt positive potential of the circuit, so Q3-Q4 and the load are all cut off. Under the "alarm" condition, on the other hand, pin 12 of IC2 is effectively shorted to the low bus of the circuit, so Q3-Q4 and the load are driven fully on.

The load of the Fig. 4 circuit can be a 12-volt lamp, with a maximum current rating of 100 mA, or 12-volt relay, with a minimum coil resistance of 120 ohms: If a relay load is used, suppression diode D9 should be wired across its coil as shown dotted in the diagram.

#### Construction notes

The final setting up of the red-line or over-speed alarm circuit is slightly involved, since the final values of R7 and R9, and possibly C2 and C3, have to be chosen to suit the specific vehicle and application in which the system is used. The actual construction, how-

ever, should present few problems, since the physical layout of the design is in no way critical, and the circuit should initially be built up complete except for the four components mentioned above.

When building the circuit, note that the speaker can have any impedance in the range 5 to 25 ohms, and that the LED can be any type with a peak current rating of 40 mA or greater.

When the unit is completed, except for R7, R9, C2 and C3, it can be given a simple functional check by connecting it to a 12-volt supply and checking that 6.8 volts is developed across C6. Then briefly short together pins 1 and 14 of IC3 and check that an audio/visual alarm output is available. When these checks are complete, the values of R7 and R9, each of which are made up of a fixed and a variable resistor in series, and also the values of C2 and C3, can be determined:

**To find the R7 and C2 values:** If the alarm circuit is to be provided with the tachometer facility, first decide what full-scale RPM reading is required on the meter: If the circuit is not to have a tachometer, decide or guess the highest RPM figure that is likely to be available from your own particular vehicle. Now look at the graph of Fig. 5 and find the frequency that corresponds to that value. Thus, a frequency of 267 Hz corresponds to 8,000 RPM on a 4-cylinder 4-cycle engine. Given this frequency, f, calculate the value of R7 (in ohms) on the basis of:

$$R7 = \frac{125,000,000}{f}$$

when C2 = .01  $\mu$ F.

In the example given above, where f = 267 Hz, this gives R7 a value of 470 K. when C2 has a value of .01  $\mu$ F. Note that, if preferred, the value of C2 can be raised to 0.1  $\mu$ F. The R7 value can then be reduced by a factor of ten, to 47 K.

Once the R7 and C2 values have been determined, C2 can be wired permanently into the circuit, and R7 can be made up from a fixed and a variable resistor in series and fixed into the circuit on a temporary basis: Note that the R7 value given above is approximate only, and represents the value with the variable resistor at its mid-setting. When R7 is in place, its precise setting, and the calibration of the tachometer, can be determined as follows:

First, wire a 1-mA moving-coil meter into the tachometer position, on either a temporary or permanent basis, and connect the circuit to a 12-volt supply. Now apply a square wave or pulse of the calculated frequency, f, with an amplitude of roughly 6.8 volts, across the R2-R3 combination via a 1K limiting resistor, after first setting R2 to its maximum value. Now adjust

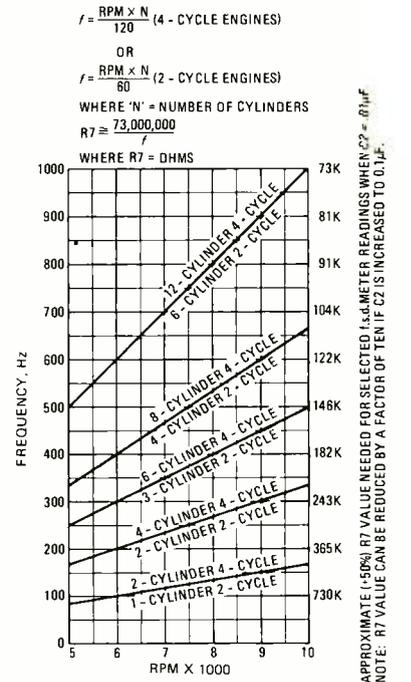


FIG. 5—RELATIONSHIP between frequency, RPM and the value of R7 needed to provide full-scale readings for different types of engines. The value of C2 is .01  $\mu$ F.

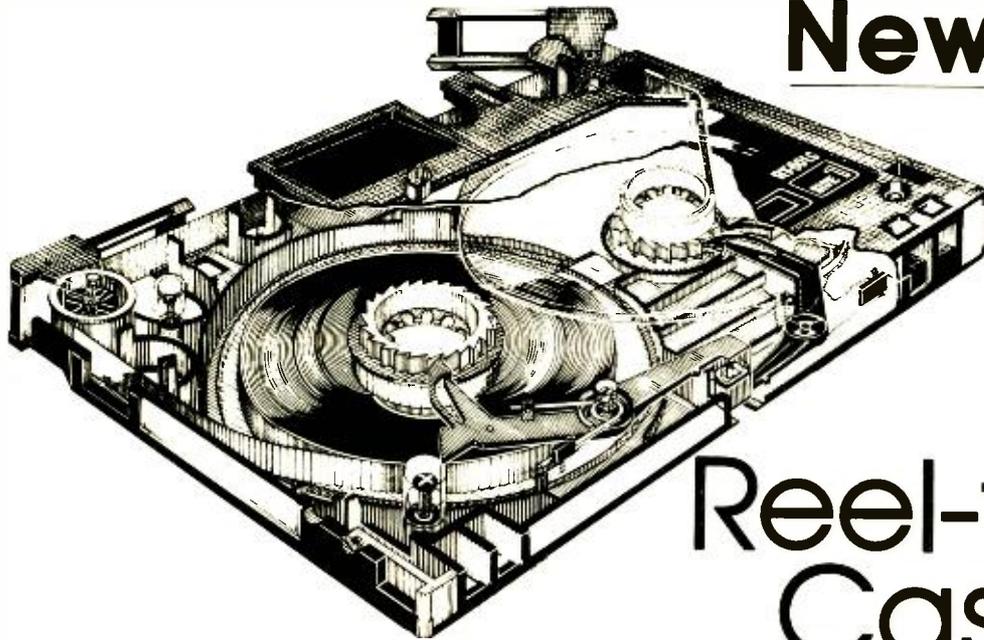
the variable part of R7 so that a reading of precisely full scale is obtained on the meter: If necessary, modify the value of the fixed part of R7 so that a full-scale reading can be obtained at the specified frequency. Once the setting of R7 has been finalized, wire it permanently into place in the circuit, and make a note of its effective value when used with an .01- $\mu$ F value of C2. The calibration of R7 and the tachometer is then complete, and the values of R9 and C3 can next be determined.

**To find the R9 and C3 values:** At this stage the tachometer section of the alarm system should be given a quick functional check in the actual vehicle. Simply connect the unit's supply leads to the vehicle's battery via the ignition switch, and connect its input terminal to the breaker points on vehicles fitted with conventional ignition, or to the high-voltage output point of the C-D unit on vehicles fitted with capacitor-discharge ignition. Next, start the engine, and adjust R2 to slightly above the minimum value at which stable RPM readings can be obtained on the tachometer.

If the alarm system is to be used simply as an RPM red-line alarm, it will suffice at this stage to merely check that the tachometer is functional. If, on the other hand, the system is to be used as a vehicle over-speed alarm, the vehicle should be driven at this stage and a careful note made of the RPM readings that correspond to the desired top-gear "alarm" road speeds. When these checks are

Continued on page 106

# New For HI-FI



## Reel-to-Reel Cassette

*At first glance it looks like an overgrown cassette, and it is! This new tape format has the same advantages and performance as the reel-to-reel format with the handling ease of a cassette*

**LEN FELDMAN**  
CONTRIBUTING HI-FI EDITOR

ON APRIL 21, 1976, THREE WELL KNOWN Japanese electronic firms announced jointly that they had developed and formulated standards for a new tape system called Elcaset. The three companies behind the project are Matsushita Electric (better known in the U.S. for its Panasonic and Technics by Panasonic products), TEAC Corporation, and Sony Corporation. Those of us who read that first trade announcement were somewhat puzzled. We wondered if some sort of masochism had infected these three giant companies. After all, the standard cassette tape (developed in the 1960's by Philips Company) had been very good to these very same companies. All of them produce a variety of stereo cassette decks in all price categories and the stereo cassette itself had reached new levels of performance, both in software (better tape formulations) and in hardware (better tape transport mechanisms, more precisely manufactured tape heads, etc.) Dolby noise-reduction systems, now almost universally incorporated in high-fidelity stereo cassette decks, had tamed the residual tape hiss level of cassettes down to acceptably low levels and all seemed right with the world. Why, then, would three companies such as these introduce yet a fourth tape format beyond presently available 8-track car-

tridges, standard cassettes and open-reel?

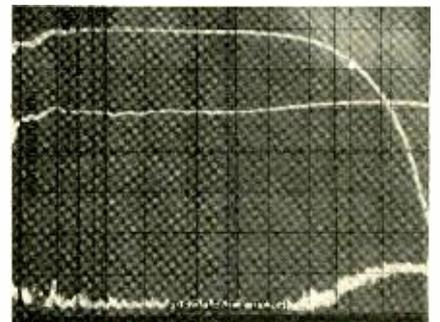
A brief quotation from an announcement distributed by Sony Corporation may shed some light on the motives of the three firms involved. "In the field of tape recorders, for example, the cassette tape recorder that was originally developed by Philips for general use has become immensely popular for recording hi-fi, as a result of its operational simplicity, convenience, and great technical improvement. However, there are still quite a number of people who are dissatisfied with the cassette tape recorder and find that open-reel tape recorders are more advantageous than the cassette for their purposes."

"Against such a background, the appearance of a new system that has the advantageous characteristics of both open-reel and cassette has long been awaited. The Elcaset was developed to meet this requirement".

### Limitations of cassettes

Before examining the new Elcaset, let's examine one of the limitations of existing standard cassettes. Certainly, thanks to the technical improvements mentioned in the announcement, cassettes used in well designed machines are capable of delivering good frequency response way out to 20,000 Hz. The slow speed (1 7/8 IPS) of standard cassettes requires, however, that a great deal of high-frequency equalization be

incorporated in the electronics of the cassette deck. Thus, while it is possible to get 20,000-Hz signals from a cassette recorded on a top-grade machine, if the recording level is kept low (at around -20 dB or so), attempts to record high-frequencies at higher recording levels causes tape saturation and treble roll-off is experienced. The frequency sweeps shown in the scope photo of Fig. 1 illustrate this effect dramatically. The

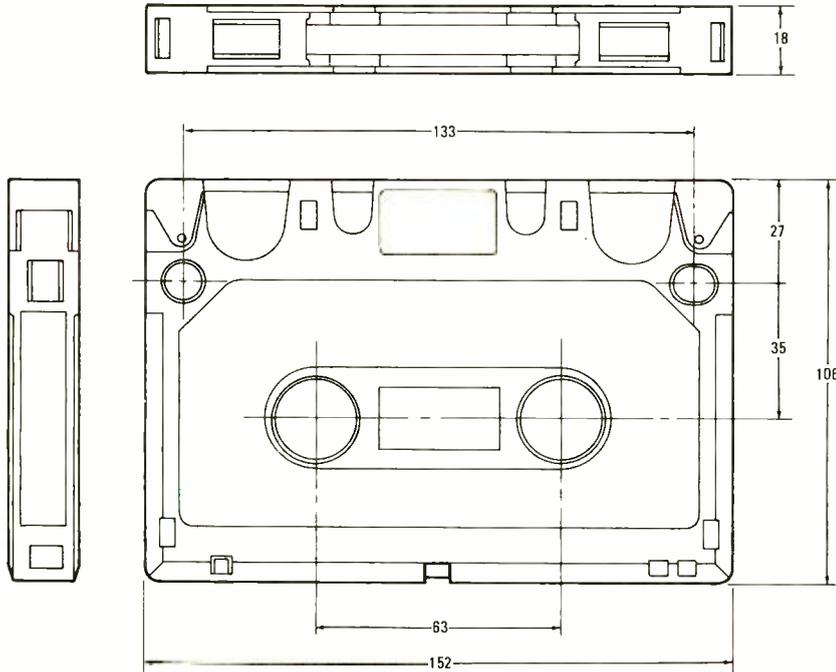


**FIG. 1—FREQUENCY RESPONSE** of a standard cassette. Upper-trace recorded at 0-dB, middle-trace recorded at -20 dB. Lower-trace is residual tape noise.

upper trace was recorded at 0-dB level, while the lower trace was recorded at a level of -20 dB. In effect, the dimensions of the tape and its low-speed limit the useful dynamic range. The lower ragged trace represents the residual tape noise, and the distance between it and the upper trace is a direct measure of



FIG. 2—ELCASET shown next to standard cassette.



NOTE: ALL DIMENSIONS IN MILLIMETERS

FIG. 3—DIMENSIONS of the new Elcaset.

usable dynamic range with this particular cassette. At 10 kHz it is only 40 dB. (Each vertical division equals 10 dB in the scope photo.)

### Elcaset

Now consider the new Elcaset, shown alongside a standard cassette in Fig. 2 for comparison purposes. Its actual dimensions are shown (in millimeters) in Fig. 3 and in more familiar inches work out to be just under 6 inches by 4.17 inches by 0.71 inches thick. The standard tape-speed of the Elcaset is  $3\frac{3}{4}$  inches per second, twice the standard

cassette speed. Tape width is one-quarter inch, the same width used in open-reel tape decks. While we have not conducted lab tests on any Elcasets as yet (machines that can handle them are just coming off production lines now), the sponsoring companies have published a dynamic-range comparison graph that is shown in Fig. 4 and is similar in presentation to our scope photo of Fig. 1. Notice that the dynamic range available at 10 kHz claimed for the Elcaset is nearly 15-dB better than that for a ferri-chrome cassette.

Another important feature of the new

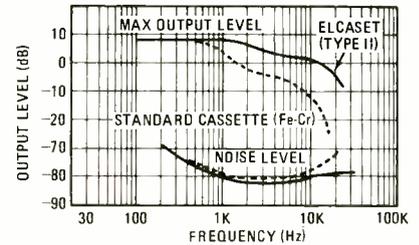


FIG. 4—FREQUENCY RESPONSE and noise level of the new Elcaset vs. the standard cassette.

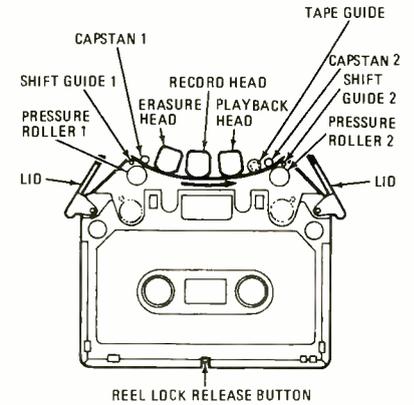


FIG. 5—TRANSPORT MECHANISM opens protective lids and pulls the tape out of the Elcaset housing.

Elcaset system is that it employs an external tape guide method that pulls the tape out of the housing and transports it across the tape heads, as shown in Fig. 5. In the case of ordinary cassettes, the record or playback head as well as the erase head push against the tape within the cassette shell so that precision of tape speed depends upon the precision of the cassette shell. In addition, the size, location and number of heads used in a cassette recorder are restricted by the limitations of the cassette into which the heads must be positioned. Only recently were a few ingenious manufacturers able to develop "three headed" cassette decks that permit the same kind of tape monitoring that is possible with open-reel decks. Since the Elcaset system employs an external tape-guide method, stable tape operation is possible and independent of the precision of the Elcaset housing. Furthermore, units with multiple heads can be more easily designed since there is virtually no restriction in the number and physical location of the heads.

### Track arrangement

The track arrangement of the Elcaset is similar to that of the standard cassette, in that the tape is divided into upper and lower halves. As shown in Fig. 6, compatibility between mono and stereo players and recorders is maintained just as it is in the case of standard cassettes. That is, a mono machine will "play" both stereo tracks of an Elcaset that might have been recorded on a stereo deck, while a stereo deck will play

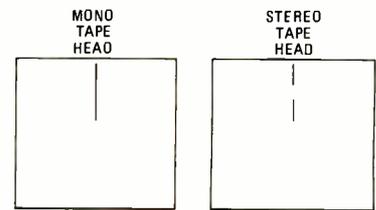
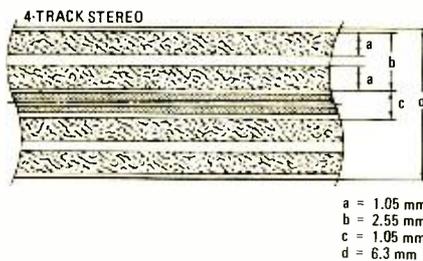
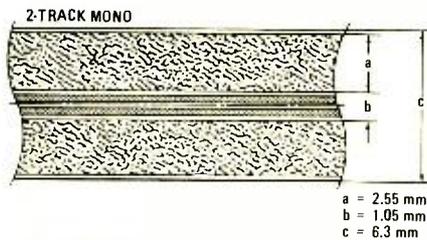


FIG. 6—TRACK ARRANGEMENT of the Elcaset.

back mono recorded programs over both channels. The standard track width assigned to the four audio tracks (two stereo pairs) is 1.05 millimeters, compared with 0.6 millimeters on the standard cassette. This provides greater area of magnetization and accounts, in part, for the greater dynamic-range capability of the new format. The guard-band between channels is 0.5 mm compared with 0.3 mm for the ordinary cassette which should improve or reduce crosstalk between channels, all other things being equal.

### New control tracks

In addition to the four normal audio

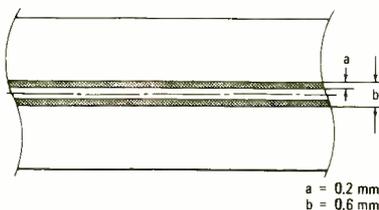


FIG. 7—CONTROL TRACKS may be used for automatic selection, synchronization or other purposes.

tracks, space has been assigned near the center of the width of Elcaset tape for a pair of narrow control tracks, one for each playing "side" of the tape. The dimensions of these special control tracks are shown in Fig. 7. According to the Elcaset's developers, a system for the automatic selection of recorded musical selections is being established as one possible use of these control tracks. Other uses suggest themselves, such as synchronizing signals for slide shows, signals that might even permit lip-synchronization with movie film and more. These control tracks will undoubtedly play an important part in future applications of the Elcaset system, especially if digital technology is coupled to the system.

### Types of Elcaset tapes

Three types of Elcaset tapes are envisioned for the new system. These are designated as Type I, Type II and Type III. Type I tape is low-noise high-output ferric oxide tape. Type II is equivalent to Ferrichrome tape while Type III will be equivalent to chromium dioxide tape.

The larger shell size of the Elcaset permits the incorporation of three types

	Compact Cassette	Elcaset	Open-Reel
<b>Size</b>	102 x 64 x 12mm (approx. 4" x 2 1/2" x 1/2")	152 x 106 x 18mm (approx. 6" x 4 1/8" x 3/4")	7" (5", 10") diameter
<b>Tape Speed</b>	1 7/8 IPS (4.8cm/s)	3 3/4 IPS (9.5cm/s)	3 3/4, 7 1/2 or 15 IPS (9.5, 19 or 38cm/s)
<b>Tape Width Thickness</b>	5/32" (3.81mm) 0.5 mils (0.012mm) with C-90 tape	1/4" (6.3mm) 0.5 mils (0.013mm) with LC-90 tape	1/4" (6.3mm) 1.5 mils (0.038mm) with long playing tape
<b>Accidental Erasure Prevention</b>	Yes (permanent)	Yes (defeatable)	None
<b>Automatic Detection</b>	CrO <sub>2</sub> Tape only	3 Types of Tape + Dolby NR	None
<b>Automatic Program Selection</b>	Starting Point only	Any Particular Program	Starting Point only (some decks)
<b>Mono/Stereo Compatibility</b>	Yes	Yes	No
<b>Adaptability to Multi-Head Configuration</b>	Possible	Easily Possible	Easily Possible
<b>Tape Threading</b>	Unnecessary	Unnecessary	Necessary

of detector notches or cavities within the shell mold itself. The first of these is a detector for the prevention of accidental tape erasure. This erasure protection scheme is a separate slide-device for side A and side B of the Elcaset that can be opened or closed easily, unlike the tabs on ordinary cassettes that cannot be restored once they are broken off.

A second detector notch in the shell was provided in anticipation of future machines that will automatically detect Types I, II and III tapes and adjust equalization and/or bias to suit the tape used.

The third detector is applicable to Dolby noise-reduction systems (or equivalent noise-reduction systems). This detection system consists of a tab located at the front of the Elcaset that, when removed, automatically indicates that noise reduction is being used. The absence of this tab could provide the necessary "instructions" to a future machine to switch in the Dolby circuitry.

### Tape protection

As we mentioned earlier, when the tape is in use it is automatically pulled out of the Elcaset shell, but to prevent

tape from spilling or popping out, a lid is attached to protect it. The lids are shown in their open position in Fig. 5 and in their closed positions in the photo of Fig. 2. In addition, to prevent tape slack from developing during transport of Elcaset, a reel lock makes contact with the tape reels themselves (see Fig. 5). Both the lids and reel locks are arranged to enable correct release action when the Elcaset is inserted into an Elcaset tape deck.

Just in case you are curious (as we were) regarding the derivation of the term Elcaset, we are told that it is a composite word derived from "L-Cassette", where "L" stands for "Large". Rather a straightforward derivation, but then again, the Elcaset seems to be a very straightforward and well thought out system from all early indications.

### Elcaset's future

In attempting to predict just what role the new Elcaset tape format will play in the coming years as far as high-fidelity applications are concerned, several questions immediately arise. As of this writing, Elcaset (in LC-60 and LC-90

*continued on page 113*

# AM STEREO

## its time has come

*Two systems are being presently proposed for the broadcast of compatible AM-stereo signals. One system—the Kahn system—has had extensive field testing for the last three years.*

BEFORE STEREO. MONOPHONIC FM RADIO limped along for years in genteel poverty with a small audience, largely of hi-fi connoisseurs and lovers of classical music. Early sales of stereo recordings and equipment were modest too, until stereo FM radio became the listening booth for the stereo-LP recording, booming the sales of stereo recordings and stereo reproducing equipment. Today, in the top fifty U.S. markets, you'll find many a stereo FM station among the top five—sometimes with an FM station leading the pack.

Daniel Yankelovich, one of America's high priests of market research, reported a few years ago that among the 15 to 30-year-olds, an expensive stereo hi-fi receiver with stereo earphones and stereo tape recorder had actually surpassed the automobile (our largest industry) as a status symbol. The youth of America have made stereo FM radio their listening medium.

AM broadcasters who have watched the steady erosion of much of their musical listening audiences, have switched their formats to talk, sports, dialogue radio, news, and all-news to hold audiences. Only in automobile listening has AM radio held its own. Here, the difficulty of receiving excellent stereo has held FM radio back. Drivetime is a crucial audience—it represents more than 35% of the total radio audience. Over 100 million car radios (mostly AM) are used in 62.47% of drivetime.

Belatedly, AM radio is now demanding equal sonic broadcasting rights—the right to broadcast in both stereo and quadriphonic sound. In the late '50's, when the National Committee for Stereophonic Broadcasting came up with an FCC-approved system for FM stereophonic broadcasting, the electronics and broadcasting industries showed so little interest in AM stereo or stereo TV that it asked the FCC to defer or drop for an indefinite period its inquiry into stereo sound for either.

### HARRY MAYNARD

Now the pressure for AM stereo among AM radio stations is so great that the FCC requested the Electronic Industries Association, in cooperation with the National Association of Broadcasters and the Institute of Electrical and Electronic Engineers Group on Broadcasting, to organize the National AM Stereophonic Radio Committee (NASRC) to study various AM radio stereophonic broadcast systems. The first meeting of the committee was held in Washington, DC, September 25, 1975. The committee announced: "Anyone interested in proposing an AM stereophonic broadcast or receiving system is encouraged to attend".

AM stereo is not a new idea. As early as 1925, an AM radio station, WPAJ in New Haven, made the first off-air AM stereo transmission using two separate AM transmitters broadcasting at different frequencies. Since then, many

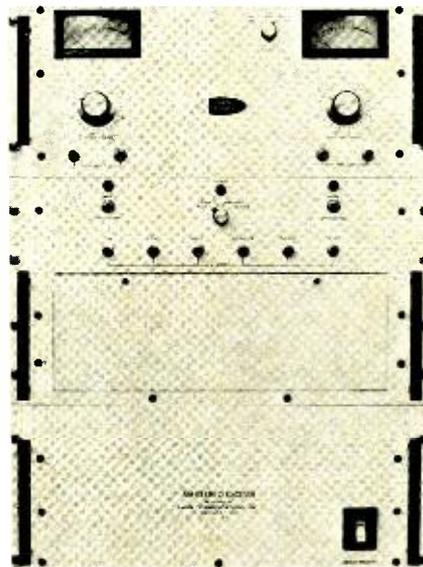
different stereo systems for generating AM stereo signals from a single transmitter have been proposed and demonstrated using independent sideband modulation, frequency modulation, phase modulation, and quadrature modulation. Westinghouse, G-E, RCA, EMI, AT&T, Philco, and CBS Labs were only a few of the companies that have proposed compatible AM stereo broadcast systems in the past.

In 1926, Potter received the first patent for an AM stereo system. It put a single carrier on two modulators, maintaining the original phase on one channel, shifting the phase 90° on the other, and combining the two linearly. The result is a waveform that varies in both phase and amplitude, a single modulated carrier with sum and difference modulations that contained all the sidebands within assigned limits. Unfortunately, a special AM stereo receiver is necessary for synchronous detection.

In 1959, RCA, over WNBC in New York City, demonstrated an AM-FM system for stereo reception using a 50-kW transmitter. Since then, RCA has, at NAB and other broadcast meetings, demonstrated their system with low-powered experimental transmissions. Figure 1 shows a block diagram of RCA's compatible AM stereo transmitter system, and Fig. 2 shows the compatible AM-FM AM stereo receiver.

Currently, to my knowledge, only two AM stereo systems are seriously being proposed—the RCA AM-FM system and the Kahn system. The recent request by the NASRC may bring forth other systems in the near future.

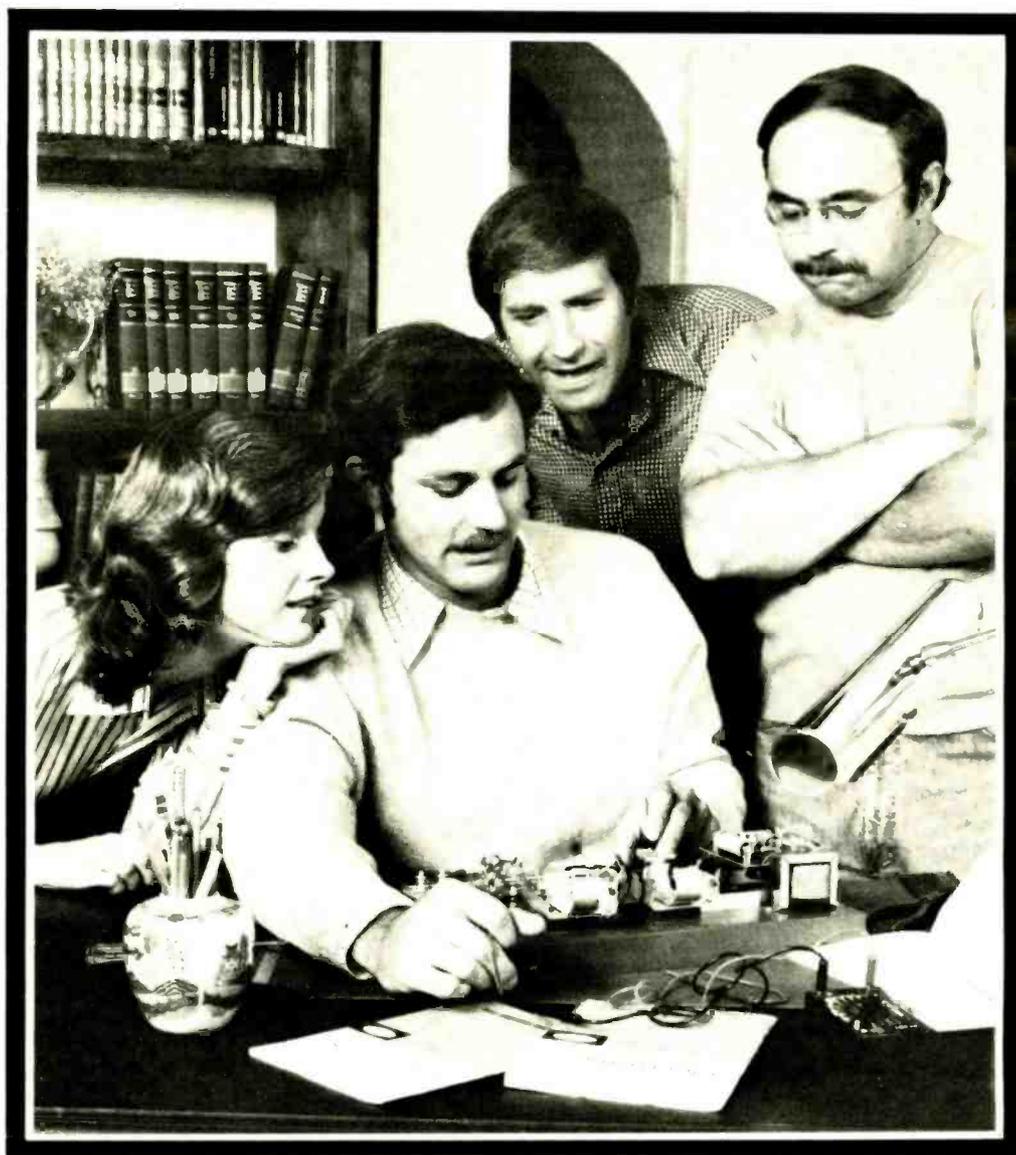
The Kahn system (see Fig. 3) has for the last 3 years had extensive field testing in Mexico, on XETRA, a 50-kW station in Tijuana covering the Southern California area. Kahn Communications, in Freeport, N.Y. is widely known in the electronics industry for many developments in radio, telephone, and other fields. Currently, with FCC



**AM-STEREO EXCITER** developed by Kahn Communications, Inc., independently modulates both AM sidebands to broadcast the stereo information.

# Herb Laney's a tough-minded optimist. How about you?

Herb takes his future seriously. Without worrying about it. He knows his CIE training is giving him valuable skills in electronics. Skills a lot of people will be glad to pay for. And that's good reason for all the optimism in the world. How about you?



Learning new skills isn't something you just breeze through. Especially in electronics. You've got to really *want* success if you're going to build your skills properly.

Herb knew that right from the start. But he also knew what rewards he could earn if he took some time and did it right. He knew that, in today's world, people who really *know* electronics find a lot of other people... even whole industries... looking for their help.

How about you? How much do you want that thrilling feeling of success... of being in demand? Enough to work for it?

### Why it pays to build skills and know-how.

One of the things that got Herb interested in electronics is that electronics seems to be something just about *everybody* needs. Almost everywhere you look these days — in a business office... a manufacturing plant... a department store... a doctor's office... a college... even your own home you'll find all kinds of electronic devices.

That spelled "opportunity" to Herb. Plus he liked the idea of having a set of skills that might lead to jobs in places as different as a TV station... a hospital... an airport... a petroleum refinery.

But what Herb liked *most* about electronics is that it's just plain *interesting*. Even though it takes time and effort to learn, the subject is so fascinating it *almost* doesn't seem like "studying" at all!

### How CIE keeps you interested.

CIE's unique study methods do a lot to *keep* you interested. Since electronics starts with ideas... with principles... CIE's Auto-programmed "Lessons help you get

the idea — at your own most comfortable pace. They break the subject into bite-size chunks so you explore each principle, step by step, until you understand it thoroughly and completely. *Then* you start to use it.

### How CIE helps you turn ideas into reality.

Depending on the program you choose, CIE helps you apply the principles you learn in a number of different ways.

If you're a beginner, you'll likely start with CIE's Experimental Electronics Laboratory. With this fascinating workbench lab, you actually perform over 200 experiments to help you grasp the basics! Plus you use a 3-in-1 precision Multimeter to learn testing, checking, and analyzing.

In some programs, you build your own 5MHz triggered-sweep, solid-state oscilloscope — and learn how to "read" waveform patterns... how to "lock them in" for closer study... how to understand and interpret what they tell you.

To help you develop practical, skill-building knowledge you then receive a Zenith 19" diagonal



solid-state color TV featuring nine removable modules. You learn how to trace signal flow... how to detect and locate malfunctions... how to restore perfect operating standards.

### What to do first.

Get all the facts. Send for CIE's FREE school catalog and career information package TODAY. Check *all* the CIE programs — and see which one's right for you. Do it now.

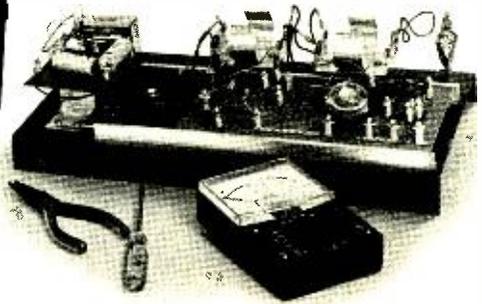
### Why it's important to get your FCC License.

More than half of CIE's courses prepare you for the FCC License exam. In fact, based on continuing surveys, better than 4 out of 5 CIE graduates who take the exam get their License!

That's important. For some jobs in electronics, you *must* have your FCC License. For others, employers often consider it a mark in your favor. It's *government-certified proof* of specific knowledge and skills!

### Free catalog!

Mail the card. If it's gone, cut out and mail the coupon. If you prefer to write, mention the name of this magazine. We'll send you a copy of CIE's FREE school catalog — plus a complete package of independent home study information! For your convenience, we'll try to have a representative call to help you with course selection. Mail the card or coupon... or write: CIE, 1776 East 17th Street, Cleveland, Ohio 44114.



**CIE** **Cleveland Institute of Electronics, Inc.**  
1776 East 17th Street, Cleveland, Ohio 44114  
Accredited Member National Home Study Council

**YES...** I want to succeed in electronics. Send me my FREE CIE school catalog — including details about all electronics courses — plus my FREE package of home study information! RE-87

NAME \_\_\_\_\_  
ADDRESS \_\_\_\_\_ (please print) \_\_\_\_\_ APT. \_\_\_\_\_  
CITY \_\_\_\_\_  
STATE \_\_\_\_\_ ZIP \_\_\_\_\_  
AGE \_\_\_\_\_ PHONE (area code) \_\_\_\_\_

Check box for G.I. Bill information:  Veteran  Active Duty

**Mail today!**

approval, the Kahn system has been extensively tested on station WFBR, a leading station in Baltimore, Maryland, since late April 1975.

The Kahn system allows the AM broadcaster to transmit stereo programs over a conventional AM transmitter—using independent sideband signals with left-channel information on one of the AM sidebands and right-channel information on the other. Sum and difference signals are, before modulation,

shifted 90° with respect to each other. Kahn is very careful to point out that his system is not the same as most conventional single-sideband systems, which introduce excessive envelope distortion when the sideband systems are not symmetrical. As Kahn, an expert in single sideband, puts it, “you cannot take a conventional sideband and use it for AM stereo without introducing considerable distortion”.

In the Kahn system, the two side-

bands are independently modulated by the two stereo channels. The resulting envelope has the same spectrum requirement and is theoretically free of distortion. In actual practice, the stereophonic transmitter adapter invented by Kahn, is claimed to not add more than 1 percent total harmonic distortion to any of the better AM transmitters built in the last 10 years. This statement is confirmed by Floyd Daisey, chief engineer of station WFBR in Baltimore, who says, “I’m not for any AM system per se, but I like the Kahn system because it’s here now, and lives up every one of its claims that I have been able to measure. For example, if I switch from mono to stereophonic reception, it cannot be detected on any existing AM monophonic receiver. On a specially constructed AM stereo receiver I’m currently measuring over 27 dB of separation with no appreciable gain in distortion”.

modestly priced AM receivers and slightly detuning each AM receiver. Placed several feet apart, with the left receiver detuned slightly below the carrier frequency, the left channel can be received. With the right radio detuned slightly above the carrier frequency, the right channel can be received.

When I first heard about this ability of the Kahn system my first reaction was to dismiss it as a gimmick, but having heard the results, I was pleasantly surprised with the considerable improvement in sound over the conventional monophonic receiver. Leonard Feldman (and others) in conjunction with tests he has run in the field of quadriphonic experimentation has discovered that 7 dB or over is enough to achieve stereophonic reception.

Floyd Daisey reports that members of the FCC who have heard “two-receiver AM reception” have been equally impressed. The implication is that the millions of Americans who for one reason or another have not seen fit to listen in the stereophonic mode, could be persuaded to try stereo in this way. Perhaps eventually they would then move up to more sophisticated AM stereo single-receiver systems. There are over 400 million radios in the hands of U.S. consumers, the largest percentage of them equipped to receive AM signals. The average household in the U.S. has 5.5 sets. More than 74 percent of teenagers, 53 percent of adult women and 55 percent of adult men own battery-powered radios for their personal use. Radio penetration in U.S. homes has now reached a total of 98.6 percent.

Recently, I invited Leonard Kahn on my “Men of Hi-Fi” program [broadcast on WNYC-FM (93.9)] in the New York area, to discuss and demonstrate, *on FM stereo, AM stereo*. This was done by broadcasting four off-air recorded stereo tapes. The first tape was a recording of a broadcast from a quality AM stereo receiver tuned to a transmitter that was approximately ten miles away. The other three were off-air low-powered broadcasts, attempting to simulate actual broadcast conditions in every way, made in the Kahn Laboratories. One tape was made by using two small transistor table radios, another with small table radios of moderate quality, the final tape with a state-of-the-art AM tuner, the kind that any quality AM-FM radio manufacturer could make with relatively little added expense or extensive modification of his existing AM-FM stereo receiver. Many experts I’ve talked to suggest that a high-quality AM stereo IC could be produced for less than \$2.00 after an AM stereo system is approved, since AM detection is so much cheaper.

How does AM stereo sound? Surprisingly good—particularly when com-

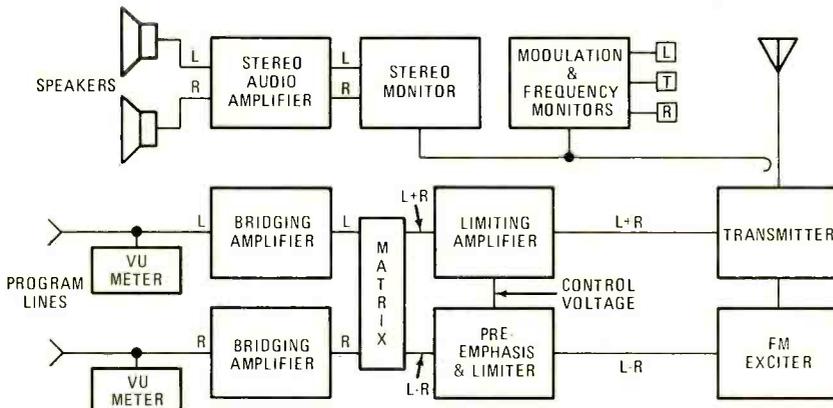


FIG. 1—COMPATIBLE STEREO BROADCAST TRANSMITTER FOR AM RADIO.

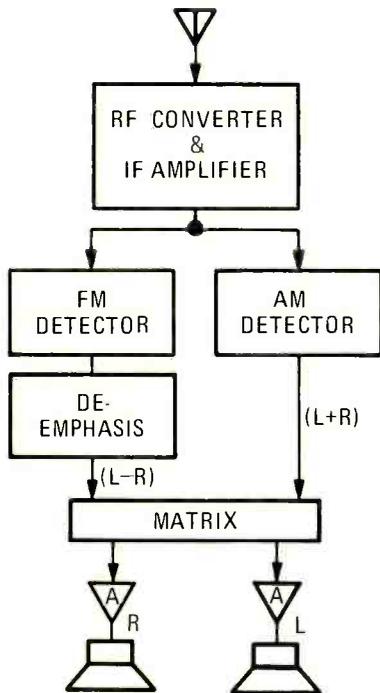


FIG. 2—RCA STEREO AM RECEIVER.

One of the great virtues of the Kahn system is that a modest separation (up to 9 dB) can be achieved using two

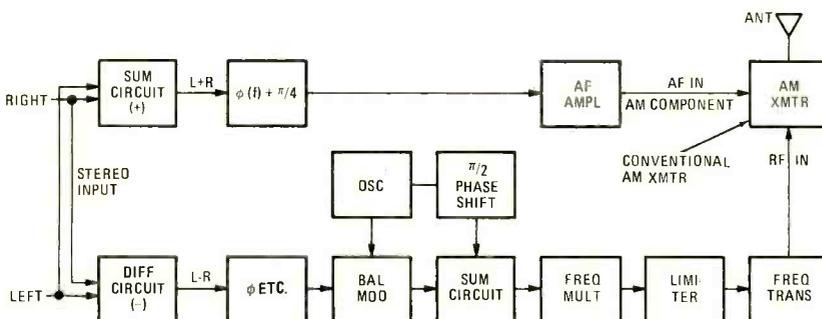


FIG. 3—THE PROPOSED KAHN COMPATIBLE AM STEREO SYSTEM.

pared to its AM monophonic counterpart. What has surprised even sophisticated listeners is how important the extra dimensionality of stereo is, even on two relatively inexpensive radios that would hardly qualify as hi-fi by today's standards. But even though millions have heard good sound on stereo FM radios and good hi-fi systems, there are also millions whose AM radios' monophonic sound is still the standard for their radio listening.

Stereo on AM radio confirms the considerable research that was done in the past in psychoacoustics. This research has demonstrated—and the history of FM's development confirms—that an improvement in dimensionality is more quickly appreciated by the general public than an improvement in bandwidth (sometimes called high fidelity).

Studies at CBS and later at Ohio State in 1945 by Roger Kirk, showed that the general public (then) voted against high fidelity 5 to 1. Other studies have confirmed (even among musicians) that appreciating a wideband, distortion-free response is, for most people, a learned response. Roger Kirk demonstrated that when members of the general public were exposed to three systems of musical frequency response: a relatively wide-range response of 40 to 10,000 Hz, a moderate range of 80 to 7,000, and a restricted range of 180 to 4,000 Hz, most people (in 1945) preferred the restricted range. Later, Kirk went further when his tests elicited a howl of protest from hi-fi buffs (I was one of them). For six weeks, Kirk exposed one group to a considerable amount of widerange listening, another group to the midrange listening, and a third group did no test listening. Afterward, the widerange group preferred its (then) wideband listening, the midrange group preferred its wide bandwidth, but the third group had not changed its opinion.

Certainly if these tests were run today, the results might be different because millions of people have been exposed to wideband systems. My own research, among 500 people who have actually bought and lived with quadriphonic sound systems, shows that 95 percent of this 500-person panel would not want to return to even stereo listening, now that they have had extensive exposure to quad.

Roger Kirk's research at Ohio State highlights that once people have been conditioned to something better, they don't want to return to a lesser mode of listening. More recent research by the Australian Institute of Electronic Engineers among the general public, shows that people more quickly appreciate stereo on narrow-band systems than on wideband systems.

When an AM stereo system is adopted, most AM broadcasters will probably not broadcast much beyond

10,000 Hz and some will use even less bandwidth. WFBR in Baltimore currently tops off at about 8,000 Hz, according to its chief engineer Floyd Daisey. However, some clear-channel stations could—if they wished—broadcast flat out to 15,000 Hz. Much AM transmitting equipment today can transmit a remarkably clean and distortion-free signal flat from 50 to 15,000 Hz.

It is a myth that all AM stations are assigned a low-fi role. The reasons for poor quality AM sound are varied, but probably the most important one is the poor quality of most AM receivers. The quality of AM transmission depends on how crowded the band is in a given area. In some areas, stations are separated by 30 kHz, which allows a frequency response of up to 15,000 Hz to be transmitted. Most good AM stations go to at least 7,500 Hz, and many a clear-channel station goes up to 10,000. There are now over 75 clear-channel AM stations in the U.S.

What seems clear to me is that current manufacturers of AM-FM receivers could adapt their current FM stereo receivers by installing a high-quality detector IC. The biggest expense of receiving AM stereo has already been met in the AM-FM stereo receiver, in the stereo preamplifier and stereo amplifier stages. My engineering friends tell me that AM detection circuits are far less complicated and not as expensive as FM detection circuits. Certainly, both AM and FM have their respective virtues and their deficiencies.

FM is relatively static-free, and has an inherently superior signal-to-noise ratio. Its capture ratio, with its ability to exclude a weaker signal at the same frequency, is well known. FM radio sounds equally good night and day. But one of the deficiencies is that an FM signal will not reach out much more than 150 miles on this earth, being essentially a line-of-sight medium. Good in-car stereo reception drops off rapidly under most conditions—particularly for in-car listening 25 miles or more from the transmitter. Multipath is a continual problem, along with the phenomenon of "picket fencing" (good sound one second, bad the next).

AM stereo has a much greater reach—not the usual 23 dB signal-to-noise loss that FM stereo has as compared to FM monophonic reception (a 200 to 1 power loss when FM stereo is used over FM monophonic reception). Leonard Kahn and others who have worked extensively with AM stereo tell me there is very little loss in signal-to-noise for AM stereo, and no degradation of signal when AM stereo is being transmitted for AM monophonic listening.

I don't see AM stereo as being anti-FM stereo, but a case of improving the breed of an important form of broadcasting (65 percent of the total radio

audience is AM) where billions of dollars have already been invested by both AM stations and their listeners. There are close to 4,500 AM stations in the United States. The car audience alone is huge, representing over 100 million potential listeners.

The cost of adding AM stereo broadcasting capability, according to Floyd Daisey at station WFBR, will be no more than the cost of existing FM stereo transmitting capability and can be added in less than an hour to any AM station—if that station has reasonably modern transmitting equipment bought in the last 10 years.

Most of the AM radio operators I have talked to see AM stereo as catalyst to improved AM transmission and reception. Many point out that AM radio does not have to be a low-fi medium. Perhaps the most pertinent comment comes from James Gabbert, president of the National Association of FM Broadcasters (which has just changed its name to the National Broadcasters Association). Gabbert is also head of the successful KIOI-FM in San Francisco, one of the first FM stations to go stereo in the U.S.

Gabbert, in recently addressing his fellow FM broadcasters, said, in pushing for discrete quadriphonic broadcasting, "Some broadcasters will look at quadriphonic as a passing fad or a flash in the pan, as many FM broadcasters thought of stereo in 1961. Few stations wanted to convert to stereo because of the investment involved. The considerations (that there weren't enough receivers, people wouldn't care and it was too expensive) proved false. Would anyone of you be willing to return to mono broadcasting today?"

"Discrete quad is a whole revolution for FM broadcasting. *Another revolution on the horizon is AM stereo. This will change the entire complexion of AM radio, making it competitive with FM, in terms of musical dimensionality and realism.*"

I agree with Gabbert on all but one count, that the only way to broadcast quad is via a discrete system. He saw what stereo could do for his station and FM radio, long before most of his fellow FM broadcasters did—he is ahead of them again in seeing what quad will do for FM radio in the future. The question I'd like to put to him is, "How long will it be before AM radio wants to broadcast in quad?"

We need both matrix and discrete quadriphonic systems for many reasons too involved to go into here. But one reason is that the only way that AM radio can have quad is via a matrix system. If I disagree with Gabbert that discrete is the *only* way to go for quad, many AM radio operators can agree with him that AM stereo's time has come.

R-E

# MYSTERY OF THE

Even though a speaker systems  
may be far greater than  
of an amplifier, tweeters

OVER THE LAST SEVERAL YEARS, WE HAVE heard from an increasing number of audio enthusiasts who have had to replace the high-frequency drivers in their multi-element speaker systems. Often, they complain that their speaker's power rating (clearly specified in the owner's manual and even occasionally on the connection plate at the rear of the speaker system) was well beyond that of their amplifier's power output capability. So, how come the tweeters "blew out?"

We decided to do a little investigating—especially since we ourselves have more than once had to replace an ailing or dead tweeter. The first thing we learned (and it came as no great surprise) is that *most* tweeters in *most* multi-speaker systems cannot handle anywhere near the input power that the woofer, or even the mid-range driver (if the system includes one) can handle. For example, a system with a power input rating of 50 watts of continuous power may include a tweeter that can handle no more than 10 watts of continuous power, or even less.

Of course, not all speaker manufacturers rate the power handling of their products in terms of continuous power (even though amplifier manufacturers are now required to do so, in accordance with FTC rules). Most makers of speaker systems continue to rate power handling of their products in terms of "program power"—a term which has never been properly defined but which suggests some sort of average music power that most experts concede is around 10 dB (one tenth the power) lower than "momentary peak power" that may occur under music signal input conditions. On that basis, our so-called "50-watt speaker" would be able to handle only about 5 watts of continuous sinewave power if you were to apply that sort of test tone to it for an extended period of time. If the five-to-one power handling capability between woofer and tweeter holds true, that means that the tweeter in question could, in theory, be destroyed if you fed a high-frequency tone to it at a level of more than 1 watt for a long period of time.

Why do manufacturers seemingly skimp on tweeter power handling capacity? One reason, of course, is the physical difficulty (and cost) of manufacturing a small tweeter (with its tiny voice coil and narrow-gauge voice-coil winding) that would be able to handle as much power as the more ruggedly fabricated woofer, which can use heavier wire in its voice coil. The theory is—and always has been—that tweeters in "real life" are never required to handle as much power as woofers or mid-range elements simply because "music doesn't happen that way."

Figure 1 shows the approximate frequency distribution for a classical symphony orchestra, averaged over some period of time. The graph was prepared in 1959 by L. J. Sivian, H. K. Dunn and S. D. White and published in the *IRE Transactions* of that year, volume AU-7.

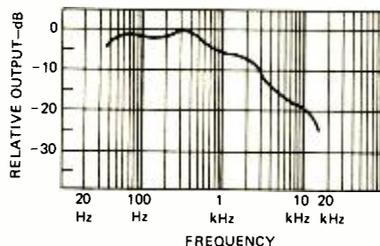


FIG. 1—FREQUENCY DISTRIBUTION, 75-piece orchestra, time-averaged. Peaks may be 10 to 20 dB greater at any instant.

According to this statistical analysis, most of the energy content is in the frequency range from about 50 Hz to 1 kHz, rolling off rather rapidly at higher frequencies, so that at 10 kHz (the frequency region where most tweeters would be reproducing sound actively in a multi-driver speaker system), average energy content is 20 dB lower than at mid-frequencies. Allowing for 10-dB peaks, which may occur in short bursts, we would still have a difference of 10 dB between the maximum energy level of music at 10 kHz and the *average* energy level of music at low and mid-frequencies. But 10 dB represents a power difference of ten to one. Thus, if an amplifier delivers peak signals of 50 watts at mid frequencies where most of the musical energy is concentrated, a tweeter might be expected to receive some 5 watts of energy at those frequencies where it is active. On that basis, the manufacturer who installs a tweeter that can take 10 watts of continuous power is actually providing a safety factor of two to one. So why the burned out tweeters?

## Yesterday's and today's music

We decided to perform some experiments, using a modern high-fidelity component system to reproduce music and speech of various kinds. The output of our system (or at least the output of one channel) was connected to a spectrum analyzer that is capable of sweeping at a very slow rate from 20 Hz to 20,000 Hz. We adjusted the sweep rate so that one full sweep took 100 seconds and permitted the sweep to continue, over and over again, for about 15 minutes. Bandwidth of the sweeping filters in the analyzer was adjusted to be narrow enough to differentiate between frequencies one third of an octave apart, yet wide enough so as not to miss

responding to musical energy of relatively short duration at specific frequencies. We tuned our FM tuner to a classical music station and let the entire dynamic range and frequency range of the music be stored on the storage oscilloscope for the full fifteen minutes. We assumed that over such a long span of time we would store a good representation of the spectral content of classical music, vintage 1976. The results are shown in the 'scope photo of Fig. 2 and, allowing for the rather random nature of the tests, conformed very closely to the statistical results of Fig. 1 plotted in 1959. So far, no solution to the mystery of the burned out tweeters. Musical energy indeed rolls off at the higher frequencies—at least if one listens to classical music.

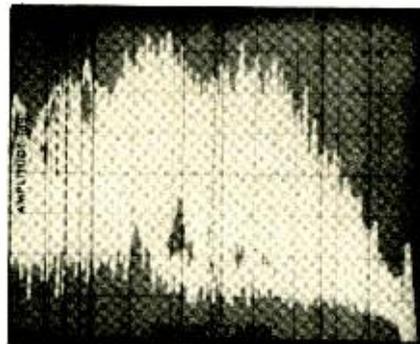


FIG. 2—SPECTRAL DISTRIBUTION of orchestra playing classical music.

## Speech frequencies

Perhaps it is the modern disc jockey, with his piercing voice, who is responsible for all those burned out tweeters? Digging back into the textbooks, we came up with a spectral distribution curve of male speech, this one prepared way back in 1940 by Dunn and White and published in the *Journal of The Acoustical Society of America*, Volume 11. Their curve of frequencies and energy levels of the male speaking voice is reproduced in Fig. 3.

Back to our FM set—this time tuned to an all-talk station—and another fifteen minutes of sweeping and storing. Sure enough, the researchers were essentially

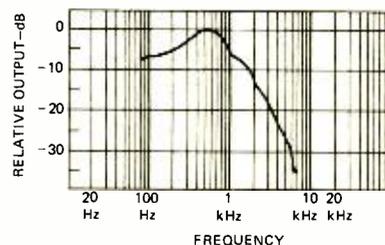


FIG. 3—VOICE OF A MALE falls off rapidly at high frequencies.

# FAILING TWEETERS

power handling capacity  
the output power rating  
often fail. Here's why

LEN FELDMAN  
CONTRIBUTING HI-FI EDITOR

correct back in 1940. Except for a few sibilant "s" sounds, which managed to cause a couple of spikes above 5 kHz in Fig. 4, speech energy *does* fall off at the

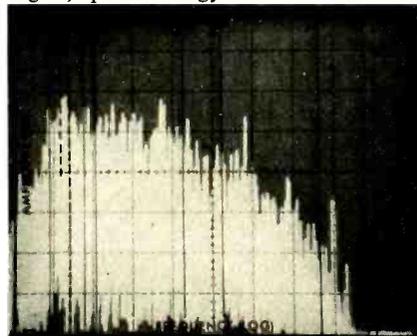


FIG. 4—FREQUENCY DISTRIBUTION of a male disc jockey's voice, averaged over a time period of 15 minutes.

predicted rate and is down about 30 dB well before reaching the 10-kHz mark on the 'scope graticule (vertical divisions are worth 10 dB each in all of these presentations). Obviously, the DJ's are not the culprits.

## How about tone controls

Suddenly, we remembered how many audiophiles delight in turning up their bass and treble controls all the way, and decided to re-check earlier results with tone controls set for maximum boost. We played the same classical selection used for the display of Fig. 2 (we had recorded it on a good open-reel tape deck just in case we needed a replay). Again, energy levels at all audio frequencies were stored for the requisite fifteen minutes and are shown in Fig. 5. Comparing results with those obtained in Fig. 2 we had our first

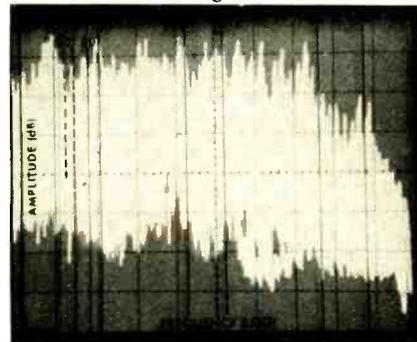


FIG. 5—BOOSTED BASS AND TREBLE controls put more power into the lower and higher ends of the frequency range.

clue as to a possible cause of tweeter failure. Now, energy levels were almost constant all the way up to about 5 kHz. At 10 kHz, energy levels were around 15 dB higher than in the classical music

played back with "flat" settings of those tone controls. Not surprising in itself—since the treble control does afford 15 dB of boost—but somewhat startling when presented this way!

## Other types of music

Recognizing that these days, most hi-fi systems are not turned on to (nor are most hi-fi listeners turned on by) classical music, we switched to a typical rock-and-roll FM station on the dial and repeated the earlier experiments, with all tone controls set flat. Results shown in Fig. 6 are

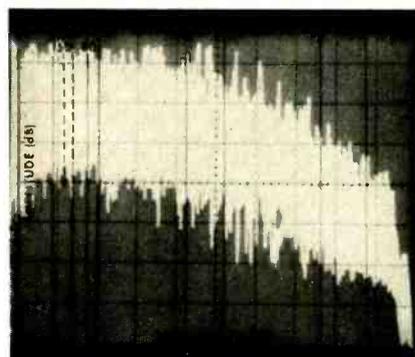


FIG. 6—ROCK MUSIC has higher bass and treble energy than has classical music.

interesting for several reasons, when compared with Fig. 2. For one thing, rock music obviously has more average bass content than does classical music. Notice that the energy from 20 Hz to 1,000 Hz is almost constant.

As for high-frequency energy, while it is significantly greater than in classical

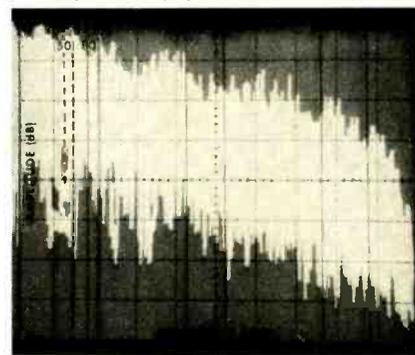


FIG. 7—SAME PIECE OF ROCK MUSIC played with treble and bass controls boosted.

music, it does roll off decidedly at the higher frequencies. Of course, adding bass and treble boost in the extreme does intensify the bass even more, and adds the usual 10 to 15 dB of additional energy at the high end of the audio spectrum, as illustrated in Fig. 7.

## Electronic music

As a final experiment in spectrum content of different types of music, we decided to "store" an example of electronic music on the spectrum analyzer. We reasoned that since this newer form of music might have a somewhat different frequency/energy distribution, since it is created by man-and-electronics made tone

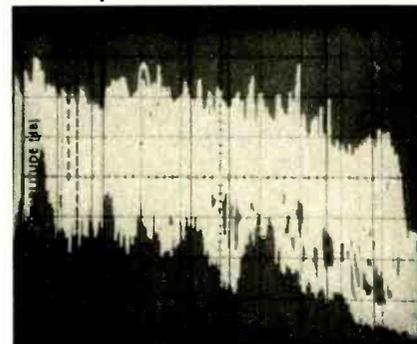


FIG. 8—ELECTRONIC MUSIC LEVELS are almost uniform to beyond 5 kilohertz.

generators, which can be as rich or as poor in harmonic overtones as the composer at the synthesizer desires.

Sure enough, results (shown in Fig. 8), first stored with tone controls set to the flat position, are unlike any "natural" music we had analyzed up to this point. Frequency distribution is almost uniform all the way up to 5 kHz (and therefore

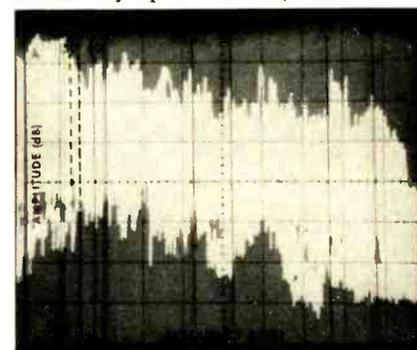


FIG. 9—SAME ELECTRONIC MUSIC as in Fig. 8, played with tone controls full "up."

easily capable of blowing up an unsuspecting tweeter that never ran into this phenomenon before). Repeating the playing with bass and treble controls full up (Fig. 9) we see that energy levels at 10 kHz are just about as great as at 1 kHz. Even super-tweeters might not have a chance to survive under these circumstances.

## Under-powering your speakers

Having concluded that some forms of modern music—reproduced with less than

ideal settings of tone controls—can actually be harmful to tweeters, we decided to explore yet another mystery. We had heard of many cases in which a tweeter was destroyed by an amplifier whose power ratings were far below the “nominal maximum power rating” of the speaker system. For example, why would an amplifier rated at 50 watts per channel destroy the tweeter in a system that had a power handling capability of 100 watts. Even if we allow for the fact that the tweeter might be rated at, say 20 watts, in line with our earlier five-to-one ratio, surely the energy level of all the types of music we have examined up to this point would never be that great at those higher frequencies.

It occurred to us that perhaps the real cause of failure lay in the fact that the amplifier was *not powerful enough* for the speakers in question. Here’s the reasoning. If an amplifier is pushed beyond “clipping,” output waveforms take on the shape illustrated in Fig. 10. The output begins to look like a square wave instead

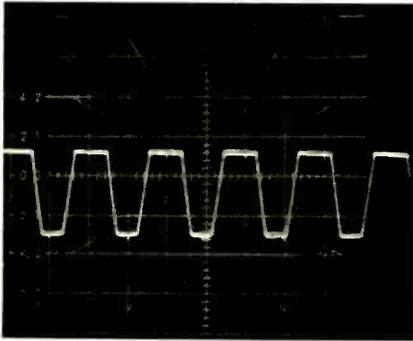


FIG. 10—OVERDRIVEN AMPLIFIER makes a 2 kHz sinewave into this square wave.

of a sine wave. We have previously discussed the usefulness of square waves in testing audio amplifiers (R-E, November, 1975), but then we were talking about square waves whose amplitude is such that they do not overdrive the amplifier in test.

As we indicated in the earlier article, a square wave really consists of its fundamental frequency plus an “infinite” number of odd-harmonic components. The same is true of a clipped sine-wave; it generates high-frequency odd-order harmonics. Thus, a 250-Hz square wave, fed to the input of a spectrum analyzer, is seen to contain frequencies at 750 Hz, 1250 Hz, 1750 Hz, etc., etc., etc., as illustrated in Fig. 11. Of course, the higher order harmonics diminish in amplitude in accordance with a well known mathemat-

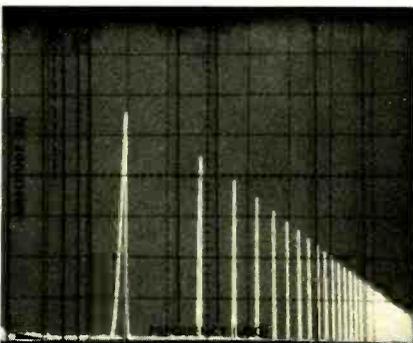


FIG. 11—SPECTRAL ANALYSIS of a 250-Hz square wave shows frequency components every 500 Hz above the fundamental frequency.

ical series, and if such a square wave were fed to an amplifier and then to a multi-driver speaker system, chances are the higher frequencies would be so far down in amplitude that no damage to the tweeter would result.

But now, consider what happens if the fundamental tone we are trying to amplify is 2000 Hz. If the volume control of your amplifier is turned up high because you want bigger sound, and a pure 2000-Hz tone comes along that is clipped by the limitations of the power amplifier, instead of an output of only 2000 Hz, there will be substantial power output at 6000 Hz, 10,000 Hz, 14,000 Hz, 18,000 Hz and beyond. The spectral content of such a square wave

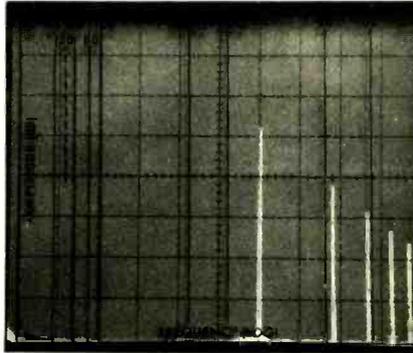


FIG. 12—OVERSIZE 2kHz SIGNAL (a near square wave) produces high-amplitude components at higher harmonic frequencies.

is illustrated in Fig. 12. Note that the level of 6000 Hz (spike to the right of the 2000-Hz fundamental) is almost equal to that of the first odd-order harmonic of the lower frequency square wave of Fig. 11. But it is at a much higher frequency—one that would seriously affect a tweeter. If the amplifier were powerful enough not to have clipped the fundamental 2000-Hz tone, this 6000-Hz component would not have appeared at the output of the amplifier (and at the speaker’s terminals) at all. Clearly, then, it is just as possible to

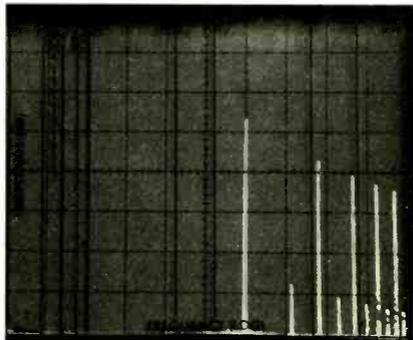


FIG. 13—ADDING TREBLE BOOST to the overdriven signal of Fig. 12 increases higher-order harmonic amplitudes even more.

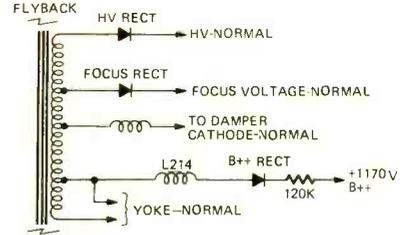
injure a tweeter by using an amplifier that has too little power output (and clips when attempting to reproduce music at adequate loudness levels) as to play some of today’s “non-conforming” music over speaker systems that are designed using frequency/energy relationships that no longer apply.

Compound this felony by boosting the treble control while overdriving the amplifier (as we did, to illustrate the point in Fig. 13) and those high frequency spikes grow even taller and more apt to blow up that overburdened tweeter. R-E

## THIN VERTICAL LINE

*All I can get on this Emerson 12P50 portable is a thin vertical line right in the middle of the screen. Tubes all good, DC voltage OK, boost voltage a little high. I subbed the yoke; no help. The horizontal hold makes the line move a little. Any ideas?—M.W., Elmhurst, NY.*

Process of elimination. You have B+, boost, and high voltage (or you would not see the line). So, you have lost your *horizontal sweep*. You were



right to substitute the horizontal winding of the deflection yoke. However, the fact that the boost is there, and high, could be saying that the yoke is OK.

There’s no smoke, so this isn’t a short. Something is *open*. A very good candidate for these symptoms would be an open C60, .1  $\mu$ F, that is the yoke return capacitor. (See diagram).

(Feedback from Reader. That was the one! Thanks!)

## HORIZONTAL SYNC HINT

If anyone ever asks about a loss of horizontal sync and intermittent sound in a Zenith 19EC45, tell them to check an open 330-ohm 1/2-watt resistor, R808, in the emitter circuit of the horizontal sawtooth shaper transistor. I’ve found this in five sets in this series.

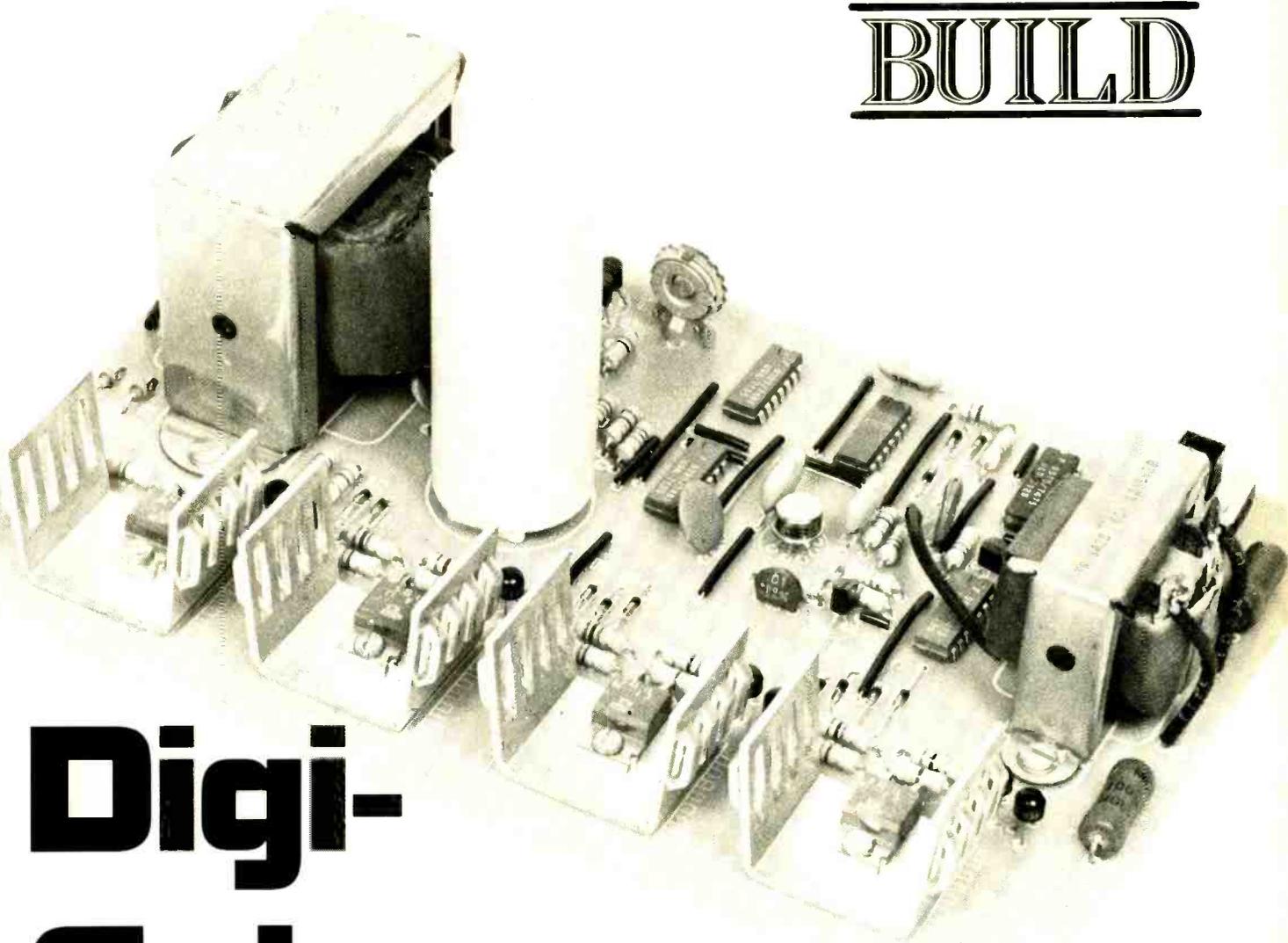
Thanks very much to William Behler, Rockaway, NY.

## RASTER TURNS RED

*There is an odd intermittent in this G-E 19JA chassis. I’ve had it in several times for the same thing. It suddenly turns red, goes out of focus and blanks out. I’ve changed modules, and the horizontal output transistor. I’m wondering if it’s the flyback. Any help will be appreciated.—R.W., Schenectady, NY.*

From the symptoms and the fact that you have changed modules, etc., I’d suspect something else. This symptom doesn’t really sound like a solid-state trouble. More like a tube problem. Since you’re somewhat limited on tubes in this chassis, how about the picture tube? A heater-cathode short in the red gun would do this.

If it is, don’t change the picture tube. Replace the three-lead heater supply transformer with the four-lead type, and you’ll isolate it.



# Digi- Colororgan

*Build this sensitive, high-speed, digitally-filtered color organ that can control 800 watts in each of its four channels*

DAN MEYER

THE DIGICOLOR ORGAN IS A SENSITIVE, HIGH-SPEED, absolute frequency discriminative digitally-filtered, four-channel color organ. High-speed TTL integrated circuits are the primary elements in the unit. They are interconnected in a circuit configuration that operates as a non-programmable digital computer. By measuring and analyzing the time period between crossings of the audio information, the Digicolor organ is able to differentiate between different frequencies and control up to 800 watts of 117-volt lights connected to each of its four channels. The results of such a unique method of audio analysis are astounding. Not only is the sensitivity high but the unit is not affected by changes in the audio level of the sound system to which it is connected. This means there is no channel mixing at high volume intervals and no loss of display action at low volume intervals. This eliminates one of

the most annoying problems that most color organs suffer from today. Another benefit of the digital circuitry is its speed. The unit is so fast that the delay in the electronic circuitry is negligible when compared with the delay in the display lights themselves. These and other features make it unique among the color organ designs known today.

### How it works

The Digicolor organ contains an externally controlled free-running oscillator whose frequency is adjustable from 5 to 50 Hz. At the onset of each pulse from the oscillator, the unit waits for the first positive-going zero-crossing of the audio information, then measures the period of time between it and the second positive-going zero crossing. Since the frequency of the cycle of music information analyzed is inversely proportional to the length of

this time period, the unit derives a binary representation of the frequency of that particular cycle measured. It then decodes this binary data, determines which one of the four channels the frequency is allocated to and turns on the bank of lights connected to that channel. This bank of lights is electronically locked on until the next cycle of audio information is analyzed. The time delay between the second zero crossing and the turning on of the circuitry controlling the appropriate bank of lights is well under 10 microseconds, which means the delay in the unit is negligible in relation to the delay in the lights themselves. Since this unit's operation is based on zero crossings, the display is not affected by changes in the volume level of the audio being analyzed. The unit's sensitivity is such that it can respond to signal amplitude levels of less than 10 millivolts RMS or 12.5 mW into 8-ohms.

# Engineers design electronic circuits —so can you!

**Only CREI offers you a choice  
of 18 home study programs  
in electronics with circuit design,  
plus special arrangements  
for engineering degrees**

Circuit design is perhaps the one qualification that distinguishes advanced technical personnel and engineers from the average electronics technician.

If you can design electronic circuits, you can more readily understand the circuitry of all types of electronic equipment. Thus you can more easily handle the repair and maintenance of such equipment, as well as assist in the development of new electronic systems.

The ability to design electronic circuits to solve practical engineering problems is one of the most valuable skills you can possess. Those with this ability are sought after and command positions of far greater responsibility, prestige and pay than the average technician.

If you are going to have a worthwhile career in the field of electronics, the ability to design circuits is a skill you will want to acquire.

## **Circuit design in all CREI programs**

CREI covers circuit design in its home study programs in electronics. This is one of the factors that makes CREI training different from most other home study schools. CREI programs, of course, are college level—the same level of training you will find in any college or university offering programs in electronic engineering technology.

CREI training, however, is designed for home study. The programs give you effective, step-by-step training to help you move up in your career in electronics by using your spare time for technical self improvement.

## **Unique Design Lab**

CREI gives you both theory and practical experience in circuit design with its Electronic Design Laboratory Program. The professional equipment included in this program allows you to construct, test out and correct the circuits you design until you have an effective circuit.

This Lab Program helps you understand advanced electronics. It also gives you practical experience in many other important areas of electronics, as in prototype construction, breadboarding, test and measurement procedures, circuit operation and behavior, characteristics of electronic components and how to apply integrated circuits.

## Career Training at Home

Only CREI offers this unique Lab Program. It is a complete college lab and, we believe, better than you will find in most colleges. The "Lab" is one of the factors that makes CREI training interesting and effective. And the professional equipment in this program becomes yours to keep and use throughout your professional career after you complete the training.

### Engineering Degree

CREI offers you special arrangements for earning engineering degrees at certain colleges and universities as part of your home study training program. An important advantage in these arrangements is that you can continue your full time job while "going to college" with CREI. This also means you can apply your CREI training in your work and get practical experience to qualify for career advancement.

### Wide Program Choice

CREI gives you a choice of specialization in 14 areas of electronics. You can select exactly the area of electronics best for your career field. You can specialize in such areas as computer electronics, communications engineering, microwave, CATV, television (broadcast) engineering and many other areas of modern electronics.

### FREE Book

In the brief space here, there isn't room to give you all of the facts about CREI college-level, home study programs in electronics. So we invite you to send for our free catalog (if you are qualified to take a CREI program). The catalog has over 80, fully illustrated pages describing your opportunities in advanced electronics and the details of CREI home study programs.

### Qualifications

You may be eligible to take a CREI college-level program in electronics if you are a high school graduate (or the true equivalent) and have previous training or experience in electronics. Program arrangements are available depending upon whether you have extensive or minimum experience in electronics.

Send for this **FREE Book** describing your opportunities and CREI college-level programs in electronics



Mail card or write describing qualifications to

**CREI** **CAPITOL  
RADIO  
ENGINEERING  
INSTITUTE**

McGraw-Hill Continuing Education Center  
3939 Wisconsin Avenue Northwest  
Washington, D.C. 20016

Accredited Member National Home Study Council

### GI Bill

*CREI programs are approved for training of veterans and servicemen under the G.I. Bill.*



OCTOBER 1976



## PARTS LIST

All resistors 1/2-watt, 10%, unless noted

- R1, R2—100 ohms, 2 watts
- R3—39 ohms
- R4—10 ohms, 1 watt
- R5, R12, R16, R20, R24, R28, R32, R36—10,000 ohms
- R6, R7, R14, R15—4,700 ohms
- R8—1 megohm linear potentiometer
- R9—100,000 ohms
- R10, R18—220 ohms
- R11, R23, R27, R31, R35—47 ohms
- R13, R21, R25, R29, R33—1,000 ohms
- R17—10,000-ohm trimmer resistor
- R19—100 ohms
- R22, R26, R30, R34—470 ohms

- C1—5,000  $\mu$ F, 10V DC, electrolytic
- C2—.047  $\mu$ F, Mylar
- C3, C5—0.1  $\mu$ F disc
- C4—.01  $\mu$ F Mylar
- C6—0.22  $\mu$ F Mylar
- C7—3,900 pF polystyrene
- C8—0.1  $\mu$ F Mylar
- C9—.01  $\mu$ F, disc
- C10—0.56  $\mu$ F, 600 V DC

- D1, D2—1N5060
- D3—5.6 V, 1 watt Zener, 1N4734 or equivalent
- D4-D17—DZ800 or 1N914 silicon diodes

- Q1—SS1123
- Q2—2N4870 or 2N4871 unijunction transistor
- Q3, Q4—2N5129
- Q5—2N4870 unijunction
- Q6, Q7, Q9, Q10, Q12, Q13, Q15, Q16—2N5139
- Q8, Q11, Q14, Q17—40668 or T2800B Triac

- IC1—LM311 voltage comparator
- IC2—7473 dual J-K flip-flop
- IC3, IC4—7493 4-bit binary counter
- IC5—7402 quad NOR gate
- IC6—7475 4-bit bistable latch

- T1—power transformer, 117 V AC primary 12.6V AC, 2A center-tapped secondary
- T2—Audio transformer, 2,000-ohm primary, 8-ohm secondary

- S1—dptd printed circuit board mounted slide switch
- S2—spst switch

- F1—fuse (see text)

**Note:** The following are available from Southwest Technical Products Corp., Box 32040, San Antonio, TX 78216: Etched and drilled PC board—\$8.50 post-paid.

Complete kit of parts, including the PC board, but less display cabinet—\$44.95, plus postage and insurance on 4 lbs.

Display cabinet semi-kit, less bulbs (assembled except for attaching and wiring the light sockets)—\$26.50. (Too large to mail, shipped bus or express collect.)

level (2.4 to 5.0 volts). When an audio source is connected to the input side of T2, the secondary voltage is fed to inputs of IC1 through the voltage-limiter consisting of D14 thru D17.

IC1 is a voltage comparator. When the voltage at its (+) input is positive with respect to the voltage at its (–) input, the output is at a logic 1 level, and when the voltage at its (+) input is negative with respect to the voltage at its (–) input, the output is at a logic 0 level. So IC1 squares off the audio waveform and puts it in a form compatible with the input of the flip-flop IC2-a.

At the first positive-going zero crossing of the audio in the T2 secondary between points U and V with Point V as the polarity reference, the output of IC1 changes from a logic 1 to a logic 0 level. As a result of this transition the outputs of IC2-a change states. The  $\bar{Q}$  output goes to a logic 0 level, causing transistor Q4 to turn off. This in turn allows the unijunction trans-

istor oscillator consisting of Q5 and its passive components to turn on. This oscillator starts toggling the string of flip-flops contained in IC3 and IC4. The Q output of each of these flip-flops changes states whenever its CP input is changed from a logic 1 to a logic 0 level.

At the second positive-going zero crossing of the audio information, the output of IC1 again changes from a logic 1 to a logic 0 level. As a result of this transition, the outputs of IC2-a again change states. This time the Q output goes back to a logic 1 level, causing transistor Q4 to turn on, which in turn shuts off the unijunction transistor oscillator Q5. The Q output makes a logic 1 to a logic 0 transition, which in turn causes the outputs IC2-b to change states. The  $\bar{Q}$  output of IC2-b goes to a logic 0 state which feeds the J input of IC2-a. Changing this input to a logic 0 state prevents the outputs of IC2-a from changing states even though its CP input sees logic 1 to logic 0 transitions.

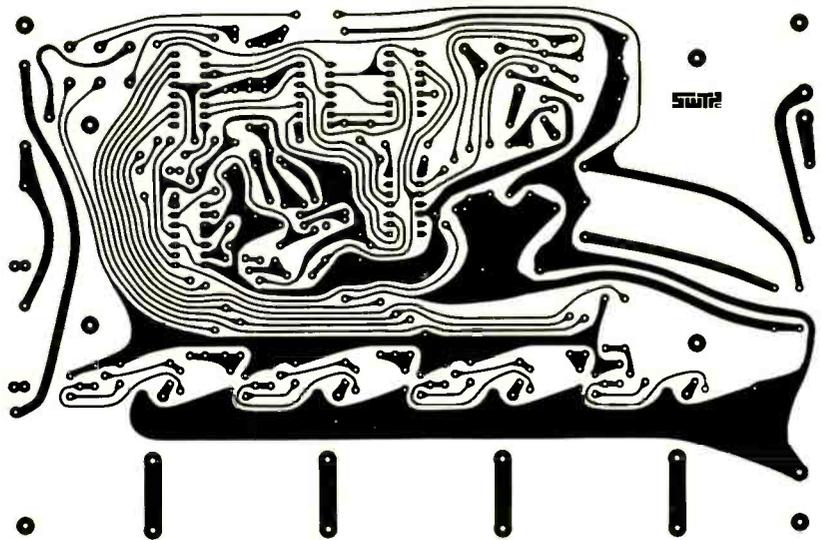


FIG. 2—PRINTED-CIRCUIT board measures 8 1/4 × 5 1/2 inches (20.96 × 13.97 centimeters).

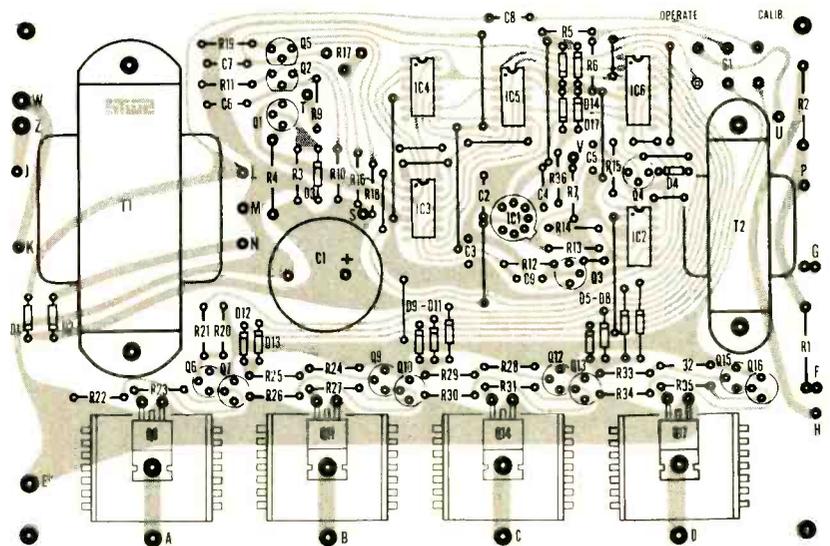


FIG. 3—COMPONENT PLACEMENT diagram.

The Q output of IC2-b goes from a logic 0 to a logic 1 level, which causes the storage integrated circuit IC6 to transfer the data from the input pins, ( $\overline{A}_1$ ,  $B_1$ ,  $\overline{C}_1$ ,  $D_1$ ) to the output pins ( $A_0$ ,  $\overline{A}_0$ ,  $B_0$ ,  $\overline{B}_0$ ,  $C_0$ ,  $\overline{C}_0$ ,  $D_0$ ,  $\overline{D}_0$ ) of the integrated circuit.

The flip-flops in IC3 and IC4 contain information which is actually a binary representation of the frequency of the cycle of audio information being analyzed. By knowing just how far the oscillator pulses of Q5 propagated through the flip-flops of IC3 and IC4, it can determine the frequency band into which the cycle of audio being analyzed falls. Since we are interested in dividing the bandwidth into four channels rather than the eight divisions provided by the flip-flops, the outputs of each adjacent pair of flip-flops are NOR'ed together by the four gates of IC5 before being fed into IC6.

The data at the output pins of the storage integrated circuit IC6 is decoded by the diode array consisting of D5 through D13. This array assures that only one bank of lights is turned on at a time. For example, if the frequency was such that the oscillator pulse train propagated through the first five flip-flops in IC3 and IC4, then the  $B_1$  and consequently the  $B_0$  pin of IC6 would be at a logic 0 level. The data on the  $C_0$ ,  $\overline{C}_0$ ,  $D_0$ , and  $\overline{D}_0$  pins of IC6 is irrelevant and must be nullified so it does not turn on another bank of lights. The diode array takes care of this nullification by eliminating all but the most significant bits of data. Each of the four outputs of the diode array feeds a triac driver circuit which in turn drives one of the four triacs Q8, Q11, Q14 or Q17. The triacs are the actual AC control elements that switch

each of the banks of lights either on or off.

The unit now remains in the previously described state until the externally controlled repetition-rate oscillator consisting of Q2 and its passive components provides a pulse. This pulse is inverted by Q3 and fed to the reset pin of IC2-b where it causes the Q output to go to a logic 0 level. This Q output is in turn connected to the store inputs of IC6, and changing this input from a logic 1 to a logic 0 level causes the outputs of IC6 to hold the data present on its outputs at the time of the logic 1 to logic 0 transition even though the data present on the inputs may change after the transition. So in other words IC6 stores data while its store inputs are in the logic 0 state.

When IC2-b was reset, the  $\overline{Q}$  output also changed states, and for the short period of time that there was a logic 1 level developed by Q2 and a simultaneous logic 1 level at the  $\overline{Q}$  output of IC2-b, a clear command was given to the flip-flops of IC3 and IC4 through the internal NAND gates of IC3 and IC4. The  $\overline{Q}$  output change of IC2-b also causes the J input of IC2-a to be returned to a logic 1 level, thus putting the unit in the same state it was in at the beginning of the discussion with the exception that a different bank of lights may be turned on, depending upon the frequency differences in the audio information being analyzed.

Regulator transistor Q1 provides the 5 volts required by most of the individual circuits in the unit. The OPERATE-CALIBRATE switch S1 provides a means of accurately setting the bandpass of the unit. When the switch is in the CALIBRATE position, a 60-Hz signal is fed from the sec-

ondary of the power transformer to the input of the comparator. Resistor R17 is then adjusted until the 60-Hz signal is right on the border line of the low-frequency channel. When the switch is back in the operate position, the audio frequency band is divided into four pairs of octave bandwidths:

CHANNEL A (LOW)	60—240 Hz
CHANNEL B (MED. LOW)	240—960 Hz
CHANNEL C (MED. HIGH)	960—3840 Hz
CHANNEL D (HIGH)	3840—15360 Hz

Since there is a connection from the  $A_1$  input of IC6 to the C input of IC2-a, the unit responds to frequencies lower than 60 Hz on the low-frequency channel.

### Construction

A printed-circuit board must be used on this project. Mount all the parts on the circuit board, Fig. 2, using the parts list and the component layout, Fig. 3. The 18 jumper wires are shown as the solid lines between holes on the component layout diagram. The center lead of each of the four triacs Q8, Q11, Q14 and Q17 as well as pin number 5 of IC1 should be cut off. (The center lead of the triac is common to the tab and is not needed.) Be sure to orient all diodes, transistors, integrated circuits and electrolytic capacitors properly before soldering them to the board. Use a low-wattage iron and 60/40 alloy resin-core solder when soldering the connections. A small heat sink is sandwiched between each triac and the circuit board and is held in place with a No. 4-40 x 3/8 in. screw, lockwasher and nut. Transformers T1 and T2 are also mounted on the circuit board, with each held in place by 6-32 x 1/4 in. screws and nuts. Transformer T2 must be oriented and connected so the primary leads attach to points U and V and the secondary leads to points P and G.

### Calibration

With the potentiometer R8 disconnected from between points S and T, temporarily attach and solder a 1-megohm 1/2-watt resistor between these two points. Solder one lead of a 6-volt 50-mA lamp to the Q7 side of R23 on the bottom of the board and solder the other lead to point E on the circuit board. Attach and solder the line cord wires to points W and Z and tape the foil side of the board between points Z, J, W and K with electrical tape to prevent accidental shock. Set the circuit board top side up on an insulating surface. Set the OPERATE-CALIBRATE switch S1 to the CALIBRATE position and turn trimmer resistor R17 so the tab on the knurl of the control faces toward the integrated circuits. Insert the line cord plug in a wall outlet. The 6-volt 50-mA lamp should light. Slowly advance control R17 toward the Q5 side of the control until the lamp just goes out. It is at this point that the unit is properly calibrated. If the unit calibrates properly, unplug the unit, remove the electrical tape, unsolder and remove the 1-megohm resistor and the 6-volt lamp and flip switch S1 back to the OPERATE position while making sure not to jar or change the setting of trimmer resistor R17.

If the 6-volt lamp fails to light or does not go out when advancing R17 something

*Continued on page 110*

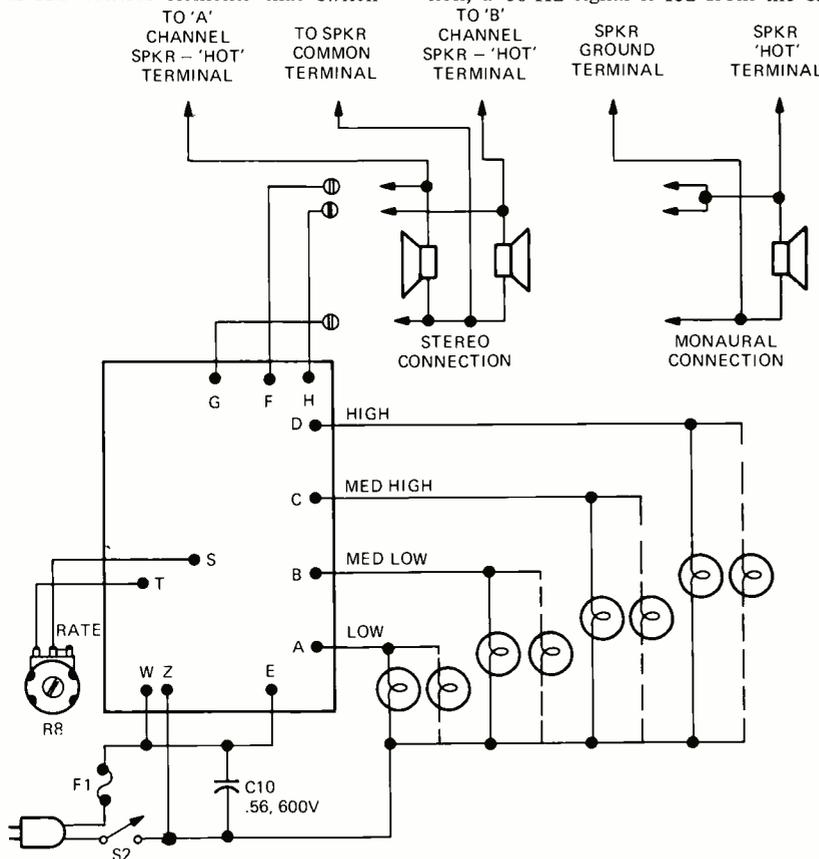
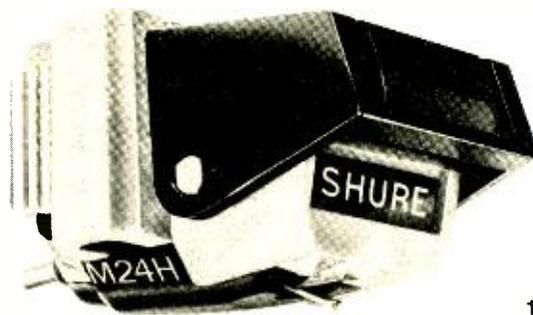


FIG. 4—DIGICOLOR ORGAN is connected directly to speaker systems. Each channel of the Digicolor organ can control 800 watts.

# Radio-Electronics Tests Shure Model M24H



**LEN FELDMAN**  
CONTRIBUTING HI-FI EDITOR

SHURE BROTHERS, INCORPORATED, IS WELL known for their fine line of stereo cartridges, the most outstanding of which is the V15 Type III, itself the descendent in a long line of excellent tracking cartridges that began with the Shure V15 many years ago. During those recent exciting years when it seemed that quadriphonic sound would become the standard method of listening to music at home, the industry was surprised and puzzled by Shure's reluctance to introduce a new cartridge that would be able to track the high-frequency information imbedded in the grooves of the new Quadradisc records. Now, even though interest in 4-channel has abated somewhat, Shure has made its long-awaited entry into the 4-channel market with what it reports is a stereo-quadriphonic cartridge that "does not have its stereo reproduction qualities compromised to accommodate full quadriphonic reproduction capabilities".

The M24H, shown in Fig. 1, physically resembles that company's Model M95ED cartridge which we had an opportunity to experiment with some months ago. The molded screw-retaining cylinders require long screws (supplied) and make mounting the cartridge into a pick-up arm shell quite easy and help to prevent that nightmare of dropping the tiny screws on a patterned floor where they invariably become invisible. The replaceable stylus assembly has an integral pivotable stylus-guard that swings down to protect the stylus itself during assembly or transportation. Staggered terminals are color-coded with the standard colors and a grounding strap connects from the right-channel ground terminal to an internal metal-shield buried beneath the outer plastic housing of the cartridge.

According to Shure, the new cartridge achieves an effective stylus mass of 0.39 milligrams which, they claim, is the lowest available in any discrete quadriphonic cartridge currently marketed. According to the manufacturer, it is this extremely low mass that results in the cartridge's high trackability and low carrier distortion.

A new stylus tip shape developed by Shure

has been named "hyperbolic" and they claim it engages more of the groove wall than is possible with either conical or elliptical styli. Based upon illustrative drawings supplied by Shure, we surmise that the new hyperbolic tip is yet another variation on the so-called Shibata-stylus first introduced by Japanese manufacturers for CD-4 record playback applications.

skating force similarly adjusted. Frequency response tests were conducted using two test records: the CBS STR-130 and JVC TRS-1004. This was necessary because most frequency response test records simply cover the range from 20 Hz to 20 kHz. The JVC test record, on the other hand, supplies a reference frequency of 1 kHz (by which we normalized output so that it was equal to that

**TABLE I**  
**RADIO-ELECTRONICS PRODUCT TEST REPORT**

Manufacturer: <b>Shure Brothers</b>		Model: <b>M24H</b>
<b>PHONOGRAPH CARTRIDGE MEASUREMENTS</b>		
	<b>R-E Measurements</b>	<b>R-E Evaluation</b>
<b>FREQUENCY RESPONSE</b> (Hz-kHz, ± dB)	20-50, +4, -2 See Fig. 2	<b>Excellent</b>
<b>STEREO SEPARATION</b>		
Separation, 1 kHz (dB)	24	<b>Good</b>
Separation, 10 kHz (dB)	18	<b>Very Good</b>
Separation, 30 kHz (dB)	16	<b>Very Good</b>
<b>CHANNEL BALANCE, 1 kHz (dB)</b>	1.3	<b>Very Good</b>
<b>TRACKABILITY MEASUREMENTS</b>		
Stylus velocity at 1 kHz (cm/s)	28	<b>Excellent</b>
Stylus velocity at 10 kHz (cm/s)	50	<b>Excellent</b>
<b>COMPONENT MATCHING CHARACTERISTICS</b>		
Output level, 1 kHz, 3.54 cm/s (mV)	3.0	
Optimum load impedance (ohms) (pF)	47K ohm; 100K ohm,* (250 pF, 100 pF*)	
Tracking force range (1 to 1/2 grams)	1 1/4	
Cartridge weight (grams)	6.0	
<b>OVERALL PHONO CARTRIDGE RATING</b>		<b>Excellent</b>

\* Values recommended for use with CD-4 records

A laminated electromechanical structure is used in the M24H and Shure claims that it reduces signal losses. This is linked to a high-energy magnetic stylus assembly for improved output in the high-frequency range.

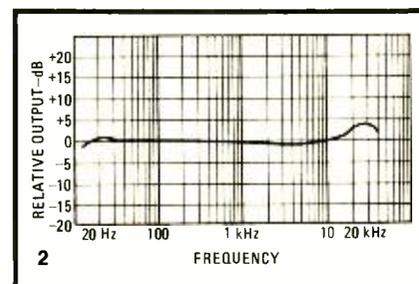
### Performance measurements

All of our lab tests were conducted with the Shure M24H mounted in the pick-up arm of a new Empire 698 turntable. Downward tracking force was adjusted to the recommended optimum of 1/4 grams, with anti-

obtained at the same test frequency using the CBS test record) followed by spot frequencies of 10 kHz, 20 kHz, 30 kHz and 40 kHz. The resulting composite frequency response curve, shown in Fig. 2, consists of swept

### MANUFACTURER'S PUBLISHED SPECIFICATIONS:

**Frequency Response:** 20 Hz to 50,000 Hz (No tolerance given). **Output Voltage:** 3.0 mV per channel at 1 kHz, 5 cm/s peak velocity. **Channel Balance:** Within 2.0 dB. **Channel Separation:** At least 22 dB @ 1kHz. **Tracking Force Range:** 1-1 1/2 grams. **DC Resistance:** 510 ohms. **Inductance:** 160 mH. **Optimum Load CD-4:** 100K ohms in parallel with 100 pF; Stereo or Matrix: 20K ohms to 100K ohms in parallel with 100 to 250 pF capacitance. **Trackability** at 1 1/4 grams: 400 Hz: 20 cm/s; 1 kHz: 28 cm/s; 10 kHz: 50 cm/s; 30 kHz: 25 cm/s. **Net Weight:** 6 grams. **Mounting Centers:** Standard 1/2-inch.



frequencies covering the audio range and spot measurements at the higher frequencies named that have been combined to form a continuous curve.

Much of the design philosophy behind the M24H becomes clear from an examination of

this response curve. Since every stereo phono cartridge exhibits a resonance at some high frequency. Shure succeeded in pushing that resonance out beyond audibility, centering it at almost precisely 30 kHz, where it serves the useful purpose of delivering greater carrier amplitudes. The carrier happens to be centered at precisely that frequency. The result, as we were to confirm in our later listening tests, is extremely flat, peak-free response in the important stereo baseband (which, according to Shure, represents between 60% and 90% of all the sound we hear when playing a CD-4 disc) and increased super-audible frequency output needed by the CD-4 demodulator.

Other vital measurements are listed in Table I. Our trackability tests (that indicate the ability of the stylus to track grooves having high velocities) were performed using Shure's own TTR-103 test record in conjunction with a handy test fixture manufactured by that company as well (their C/PEK-3 Tester). We confirmed good tracking at 28 centimeters-per-second for a 1 kHz tone and 50 centimeters-per-second for a 10 kHz tone recorded at that velocity. While we did not test for other velocities at other frequencies, Shure supplied us with a curve of trackability versus frequency (shown in Fig. 3) that we

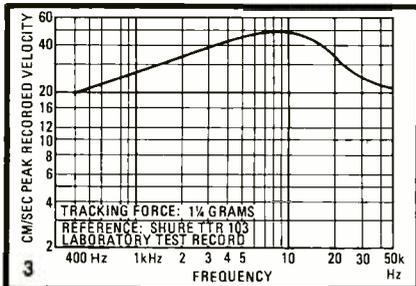


TABLE II	
RADIO-ELECTRONICS PRODUCT TEST REPORT	
Manufacturer: <b>Shure Brothers</b>	Model: <b>M24H</b>
OVERALL PRODUCT ANALYSIS	
Retail price	<b>\$74.95</b>
Price category	<b>Medium</b>
Price/performance ratio	<b>Excellent</b>
Sound quality	<b>Excellent</b>
Mechanical Performance	<b>Very good</b>
<p>Comments: The audio industry had been wondering why Shure Bros. waited so long to produce a CD-4 compatible cartridge when just about everyone else in the cartridge field had quickly produced one or more models that could track the high frequencies contained in a quadradisc. Well, perhaps Shure Bros. knew what they were doing after all, and will have the last laugh. Design emphasis seems to be applied towards excellent stereo reproduction as well as good recovery of all the complex signals contained in a discrete 4-channel disc. Resonance has been pushed out way beyond audible limits and positioned almost precisely at the 30 kHz CD-4 carrier point which not only makes for very smooth peak-free audio response that may actually take some getting used to but delivers extra carrier amplitude to work easily even with early generation CD-4 demodulators that were not sensitive enough to operate correctly with many of the earlier CD-4 cartridges produced by competing manufacturers. The low downward tracking force (we recovered CD-4 information perfectly at 1 gram force, though measurements were made at the recommended optimum value of 1.25 grams) combined with what Shure calls its "hyperbolic" shaped stylus tip actually results in less stylus pressure on groove walls than might be applied with conical or elliptical styli operating at higher downward tracking forces. The expected Shure quality is abundantly present in the M24H, and even though 4-channel is not presently the hottest thing around, this cartridge should not be overlooked as a fine stereo cartridge that will not require replacement if and when 4-channel takes off again.</p>	

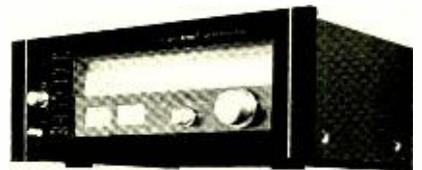
have every reason to believe is accurate, based upon our other measurements.

### Summary

In our comments following our overall product analysis (Table II) we mention the fact that listeners may find the musical accuracy of the M24H unnerving at first, especially if they have been conditioned to

expect that high-end sizzle that is so characteristic of many stereo cartridges (but not faithful to the original recorded signals). To our taste, we would rather have the smooth accurate response of a cartridge such as the Shure M24H than the artificially peaked high-end that is enjoyed by some. Accordingly, the M24H rates high in our list of cartridges we have known and loved. **R-E**

# Sansui Tuner Model TU-9900



### MANUFACTURER'S PUBLISHED SPECIFICATIONS

**NOTE:** Many of the specifications associated with this tuner are presented as two readings; one for the "narrow" bandwidth setting and one for the "wide" bandwidth setting. In the following listings, such specs are separated by a slash mark (/) with wide-band readings listed to the left of the slash, and narrow band readings to the right.

#### FM SECTION

**IHF Sensitivity:** 1.5  $\mu$ V (9.0 dBf). **Signal-to-Noise Ratio:** mono, 80 dB; stereo, 76 dB. **Harmonic Distortion:** 1 kHz: mono, 0.06/0.5%; stereo 1 kHz, 0.08/0.8%; 50 Hz, 0.1/0.8%; 10 kHz, 0.15/1.2%. **Selectivity:** 55/90 dB. **Capture Ratio:** 1.0/3.0 dB. **AM Suppression:** 58 dB. **Image Rejection:** Better than 100 dB. **IF Rejection:** Better than 110 dB. **Spurious Rejection:** Better than 110 dB. **Stereo Separation** 1 kHz: 50/30 dB. **Frequency Response:** 30 to 15,000 Hz, +0.5, -0.8 dB.

#### AM SECTION:

Sensitivity: 45 dB/m (internal antenna). **Selectivity:** 70 dB. **Image Rejection:** Better than 100 dB/m. **IF Rejection:** Better than 100 dB/m.

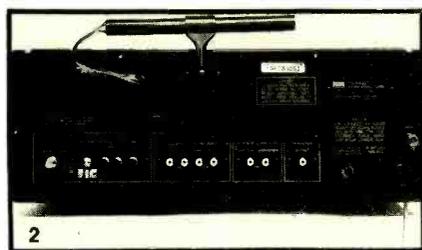
#### GENERAL SPECIFICATIONS:

Output Level: (variable) 0 to 1.0 volts; dolby outputs, 0.4 volts. **Power Requirements:** 120 VAC 50/60 Hz, 23 watts maximum. **Dimensions:** 18<sup>1</sup>/<sub>8</sub>" wide  $\times$  6<sup>5</sup>/<sub>16</sub>" high  $\times$  12<sup>1</sup>/<sub>4</sub>" deep (46 W.  $\times$  16 H.  $\times$  31.1 D. cm). **Net Weight:** 21.2 lbs (9.62 Kg.) Retail Price: \$450.00.

DESIGNING STATE-OF-THE-ART TUNERS SEEMS to have become an engineering exercise with many of the world's leading high-fidelity engineering departments. The latest such "high-end" tuner to appear in our laboratories for test and evaluation is Sansui's new TU-9900. Perhaps the most outstanding characteristic of this new tuner is its selectable IF bandwidth, about which we shall have more to say in a moment. For the moment, let's examine the interesting looking front-panel of this tuner (Fig. 1). This thick, black, front-panel extends beyond the dimensions of the chassis and its metal wrap on all sides so that the unit could be easily custom mounted in a wood cabinet or other suitable piece of furniture. Contrasting with the black outer section, the highly visible light-colored dial area has a back sloped section on which a linear FM and an AM dial-scale are printed. Calibration marks for FM are at every quarter of a megahertz. A vertical, brown, section of the panel, also located

behind the dial glass, houses a pair of meters—signal strength and center-of-channel tuning. The signal-strength meter doubles as a multipath indicator when a button is depressed. This section also contains a stereo indicator light, a three position selector switch (AM, FM-AUTO and MONO) with accompanying indicator lights and a massive tuning knob. One good twist of that tuning knob is enough to send the dial pointer scurrying smoothly across the entire span from 88 to 108 MHz or from 530 to 1600 kHz. To the left of the somewhat asymmetrically positioned dial area are seven buttons arranged in a vertical row. In addition to the meter selector just described, six other buttons handle antenna attenuation, bandwidth selection (wide or narrow), a noise cancelling circuit, a built-in calibration tone oscillator (useful for setting up level controls on associated recording equipment, and set to correspond to 10-dB below 100% FM-modulation output) and a low-pass filter switch that effectively cuts out residual subcarrier (19 and 38 kHz) signals without materially affecting audio-frequency response. A rotary output-level control and a toggle power switch complete the front-panel layout.

The rear panel, shown in Fig. 2, has a

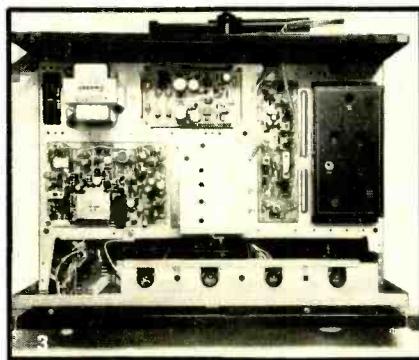


coaxial connector as well as conventional screw terminals for connection of either a 75-ohm or a 300-ohm transmission line. An external AM antenna terminal is also provided. Output terminals are incorporated for variable output as well as for fixed output. The fixed-output terminals (which deliver approximately 0.4 volts for 100% modulation) are labelled DOLBY OUTPUTS, which may be a bit confusing to the user even though they are correctly described in the manual. Specifically, the Dolby outputs do have a passive network that converts the de-emphasis characteristic from 75 microseconds to 25 microseconds (at the expense of some output level) but an onboard Dolby decoder or adaptor would still be necessary if you want to enjoy Dolby broadcasts in properly decoded form. An additional pair of jacks are included for connecting to the horizontal and vertical inputs of any oscilloscope for more precise observation of multipath interference (and for proper orientation of your external FM antenna), as is a single detector output jack intended for future connection to a 4-channel FM adaptor if discrete 4-channel broadcasting should be approved by the FCC at some future date. A convenience AC outlet (unswitched) and a chassis ground terminal are also included on the rear panel of the TU-9900 tuner.

### Construction and circuitry

Six major circuit modules and four smaller ones make up the circuitry of the TU-9900 tuner. Five of these are visible in the photo of Fig. 3. The shielded front-end is located in

TABLE I RADIO-ELECTRONICS PRODUCT TEST REPORT			
Manufacturer: <b>Sansui</b>		Model: <b>TU-9900</b>	
FM PERFORMANCE MEASUREMENTS			
<b>SENSITIVITY, NOISE AND FREEDOM FROM INTERFERENCE</b>	<b>R-E Measurement</b>		<b>R-E Evaluation</b>
IHF sensitivity, mono: ( $\mu$ V) (dBf)	<b>WIDE</b>	<b>NARROW</b>	
Sensitivity, stereo ( $\mu$ V) (dBf)	1.5 (9.0)	1.7 (10.0)	Superb
50 dB quieting signal, mono ( $\mu$ V) (dBf)	5.0 (19.4)	3.0 (14.9)	Excellent
50 dB quieting signal, stereo ( $\mu$ V) (dBf)	2.2 (12.2)	2.0 (11.4)	Excellent
Maximum S/N ratio, mono (dB)	28 (34.3)	22 (32.2)	Superb
Maximum S/N ratio, stereo (dB)	84	84	Superb
Capture ratio (dB)	73	73	Excellent
AM suppression (dB)	1.0	3.3	Excellent
Image rejection (dB)	60	—	Very good
IF rejection (dB)	100+	—	Excellent
Spurious rejection (dB)	100+	—	Excellent
Alternate channel selectivity (dB)	100+	—	Excellent
	57	95	See Text
<b>FIDELITY AND DISTORTION MEASUREMENTS</b>			
Frequency response, 50 Hz to 15 kHz ( $\pm$ dB)	+ 0.3	-0.5	Very Good
Harmonic distortion, 1 kHz, mono (%)	0.037	0.20	Superb
Harmonic distortion, 1 kHz, stereo (%)	0.037	0.55	Superb
Harmonic distortion, 100 Hz, mono (%)	0.075	0.075	Excellent
Harmonic distortion, 100 Hz, stereo (%)	0.075	0.095	Excellent
Harmonic distortion, 6 kHz, mono (%)	0.075	0.65	Superb
Harmonic distortion, 6 kHz, stereo (%)	0.10	0.50	Superb
Distortion at 50 dB quieting, mono (%)	1.0	1.3	Good
Distortion at 50 dB quieting, stereo (%)	0.3	1.3	Very good
<b>STEREO PERFORMANCE MEASUREMENTS</b>			
Stereo threshold (mV) (dBf)	5.0 (19.3)	3.0 (14.9)	Very Good
Separation, 1 kHz (dB)	46	42	Excellent
Separation, 100 Hz (dB)	43	39	Excellent
Separation, 10 kHz (dB)	36	40	Superb
<b>MISCELLANEOUS MEASUREMENTS</b>			
Muting threshold ( $\mu$ V) (dBf)	5.0 (19.3)	3.3 (15.8)	Good
Dial calibration accuracy ( $\pm$ kHz @ MHz)	-2 MHz	—	Fair
<b>EVALUATION OF CONTROLS, DESIGN, CONSTRUCTION</b>			
Control layout			Excellent
Ease of tuning			Superb
Accuracy of meters or other tuning aids			Excellent
Usefulness of other controls			Very Good
Construction and internal layout			Excellent
Ease of servicing			Excellent
Evaluation of extra features, if any			Superb
<b>OVERALL FM PERFORMANCE RATING</b>			
			Excellent



the right portion of the photo and the shielded FM IF section is also clearly visible, with access holes for alignment also seen in the photo. The front-end of the tuner contains three dual-gate FET's, two of which are used as RF amplifiers. In the wideband position, the IF section uses two 6-pole LC block filters while the narrowband setting adds an additional narrowband ceramic-filter is added. A wideband ratio detector is used ahead of a phase-locked-loop multiplex demodulator. A sharp low-pass filter follows the demodulator. A dual element ceramic-filter plus a double-tuned circuit are used in the completely separate three-gang tuned

AM section of the TU-9900. The FM antenna attenuator switch inserts a 30-dB pad in the antenna circuit preventing overload from unusually nearby strong signals.

### FM measurements

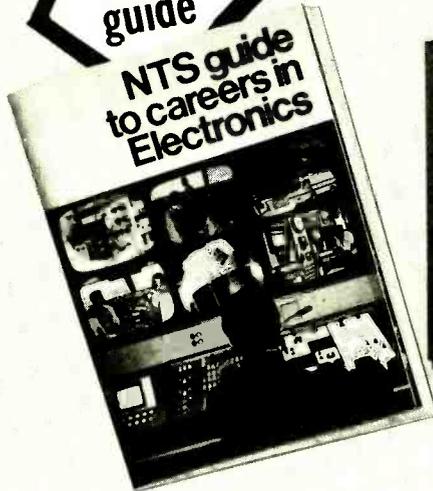
The measurements listed in Table I take on a somewhat different form, since many of the performance results differ depending upon whether the tuner is set to the wideband or narrowband position. In the narrowband position, distortion readings are anything but outstanding, but this is to be expected since narrowing the IF bandwidth restricts the ability of the circuit to linearly pass the complex sideband information that is contained in a received FM signal.

Note that the 100 Hz THD in mono is the same regardless of which bandpass mode is chosen, whereas at higher modulating frequencies (such as at the 6-kHz test frequency), the higher-order sidebands generated by such a modulating frequency are "lopped off" in the narrowband position. This results in distortion readings that are a whole order or magnitude greater than when tested in the wideband position. But oh, those wideband readings! We have never measured distortion that is any lower for any tuner ever tested.

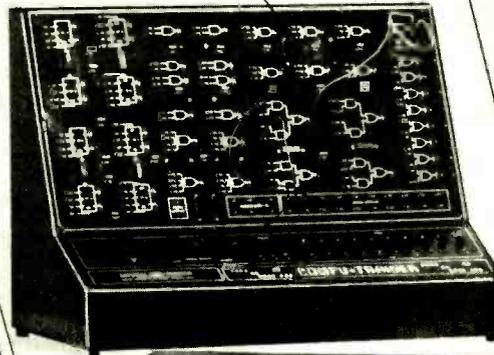
The signal-to-noise reading of 84 dB in mono is an all-time lab record for us as well

# The better the training the better you'll

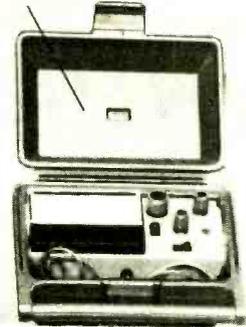
Send for  
**FREE**  
illustrated  
career  
guide



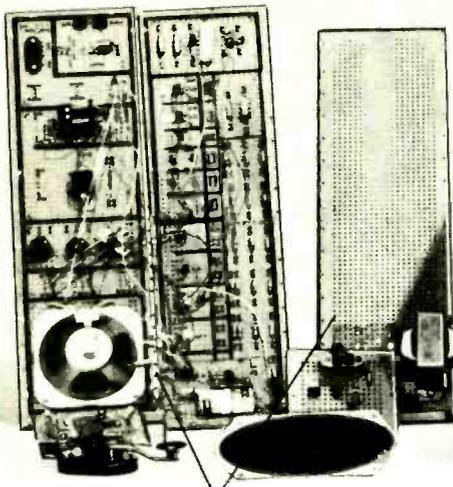
IN-CIRCUIT TRANSISTOR TESTER  
COMPU-TRAINER



TROUBLESHOOTER  
VOM



SOLID-STATE  
OSCILLOSCOPE



ELECTRO-LAB



(Simulated TV Reception)

As an NTS student you'll acquire the know-how that comes with first-hand training on NTS professional equipment. **Equipment you'll build and keep.** Our courses include equipment like the **NTS/Heath Digital GR-2000 Solid State color TV** with first-ever features like silent varactor diode tuning; digital channel selection, (with optional digital clock), and big 315 sq. in. ultra-rectangular screen.

Also pictured above are other units — 5" solid state oscilloscope, vector monitor scope, solid-state stereo AM-FM receiver with twin speakers, digital multi-meter, and more. It's the kind of better equipment that gets you better equipped for the electronics industry.

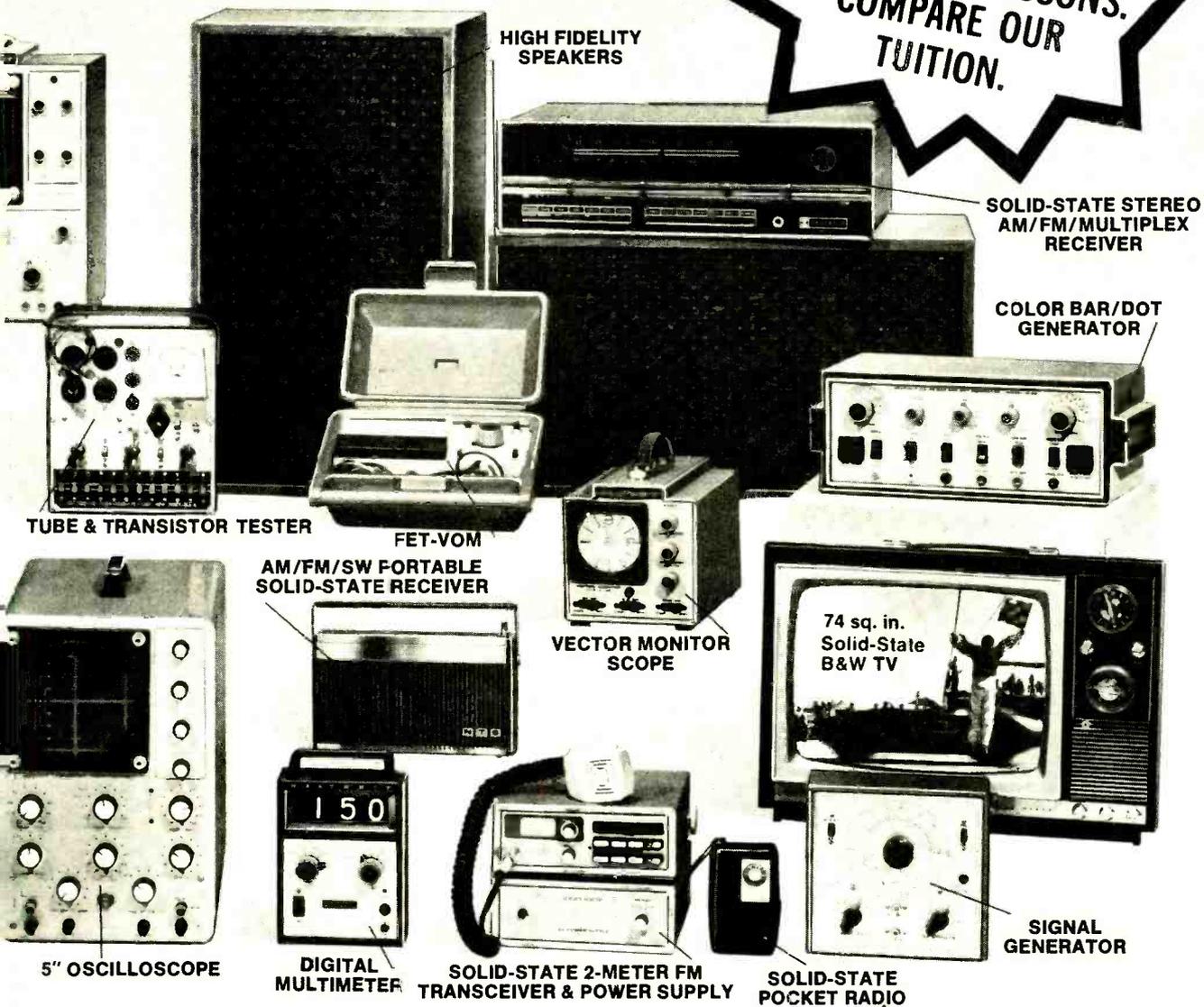
This electronic gear is not only designed for training; it's field-type — like you'll meet on the job, or when you're making service calls. And with NTS easy-to-read, profusely illustrated lessons you learn the theory behind these tools of the trade.

**Choose from 12 NTS courses** covering a wide range of fields in electronics, each complete with equipment, lessons, and manuals to make your training more practical and interesting.

**Compare our training; compare our lower tuition.** We employ no salesmen, pay no commissions. You receive all home-study information by mail only. All Kits, lessons, and experiments are described in full color. Most liberal refund policy and cancella-

# and the equipment be equipped.

COMPARE OUR  
KITS AND LESSONS.  
COMPARE OUR  
TUITION.



tion privileges spelled out. Make your own comparisons, your own decision. Mail card today, or clip coupon if card is missing.

**NO OBLIGATION. NO SALESMAN WILL CALL**

**APPROVED FOR VETERAN TRAINING**  
Get facts on new 2-year extension

**NATIONAL TECHNICAL SCHOOLS**

TECHNICAL-TRADE TRAINING SINCE 1905  
Resident and Home-Study Schools  
4000 So. Figueroa St., Los Angeles, Calif. 90037

**NATIONAL TECHNICAL SCHOOLS** Dept. 206-106  
4000 South Figueroa St., Los Angeles, Calif. 90037  
Please send FREE Color Catalog and Sample Lesson.  
NO OBLIGATION. NO SALESMAN WILL CALL.

- |   |  |
|---|--|
| <input type="checkbox"/> Color TV Servicing           | <input type="checkbox"/> Electronics Technology      |
| <input type="checkbox"/> B & W TV and Radio Servicing | <input type="checkbox"/> Computer Electronics        |
| <input type="checkbox"/> Electronic Communications    | <input type="checkbox"/> Basic Electronics           |
| <input type="checkbox"/> FCC License Course           | <input type="checkbox"/> Audio Electronics Servicing |

NAME \_\_\_\_\_ AGE \_\_\_\_\_

ADDRESS \_\_\_\_\_ APT # \_\_\_\_\_

CITY \_\_\_\_\_ STATE \_\_\_\_\_

Please fill in Zip Code for fast service \_\_\_\_\_

- Check if interested in G.I. Bill information.  
 Check if interested ONLY in classroom training in Los Angeles.

and the stereo 50-dB quieting point, which in most cases requires around 35  $\mu\text{V}$  (36.3 dBf), is achieved on this remarkable tuner with an input signal of only 28  $\mu\text{V}$  (34.3 dBf) or 22.0  $\mu\text{V}$  (32.2 dBf) in the narrowband position. The penalty one has to pay in using the wideband position is, of course, reduced alternate channel selectivity, which means that if you are in the unhappy position of living in an area that has a very crowded FM band, you may not be able to avail yourself of the incredible performance that this tuner can deliver when set to the wideband mode.

Note that in the wideband mode, selectivity is a mediocre 57 dB; whereas when the narrowband mode is selected, it increases to a superb 95 dB. It's all a matter of tradeoffs, though we believe that Sansui might have made the narrowband mode just a little *less* narrow than they did so that the differences in performance between the two positions would not be quite as great as they are.

Separation, which was supposed to undergo some appreciable degradation when the receiver is operated in the narrow mode, remained surprisingly good (42 dB at mid-band). In the wideband mode, however, we were not able to achieve the mid-band separation of 50 dB as claimed. Stereo threshold was just about where we would like to see it, as was the muting threshold which is not customer adjustable. We were somewhat surprised to find that frequency calibration of the tuner was off by a consistent 200 kHz all the way from one end of the dial to the other. A repositioning of the dial pointer by a small amount would correct this, since the error is consistent from 88 MHz to 108 MHz and did not seem to be a function of misalignment (after all, we did read an incredible 1.5  $\mu\text{V}$  of IHF sensitivity in the wideband mode—the lowest reading possible at 300 ohms and the best we have ever read).

### Listening tests

If anything, using the *TU-9900* to listen to local FM fare in our area merely points up once again just how bad some FM signals are. With a tuner such as this, it is really possible to judge station signal quality, for any differences in distortion that are audible

TABLE II	
RADIO-ELECTRONICS PRODUCT TEST REPORT	
Manufacturer: <b>Sansui</b>	Model: <b>TU-9900</b>
<b>OVERALL PRODUCT ANALYSIS</b>	
Retail price	<b>\$450.00</b>
Price category	<b>Medium/High</b>
Price/performance ratio	<b>Superb</b>
Styling and appearance	<b>Very good</b>
Sound quality	<b>Excellent</b>
Mechanical performance	<b>Excellent</b>
<p>Comments: Any tuner designer is faced with a series of tradeoffs. If IF bandwidth is made too wide, selectivity suffers, though low orders of distortion can be achieved. If too narrow bandwidth is chosen, selectivity can be made as high as desired, but needed sideband energy contained in the modulation pattern of the FM signal is attenuated with resulting distortion in recovered audio. Sansui has solved this problem by providing the best of both worlds. Offering selectable bandwidth (wide and narrow) lets the user who is not plagued by closely spaced stations enjoy FM reception at its very finest, while the user in a crowded signal area has the option of listening to a bit higher distortion in return for being able to separate out those closely packed stations on the dial. The idea is not new (Yamaha and McIntosh have had such variable bandwidth FM circuits on the market for some time) but never has it been executed so as to achieve the incredibly low distortion figures (in the wide position) which we measured for this magnificent tuner. One measurement "record" after another was "broken" as we put this tuner through its paces. For example, the 84 dB S/N ratio measured was thought to be beyond the capability of our test equipment—but that is what we were able to read in the mono mode of the Sansui TU-9900. Most amazing of all is the price of this tuner. At a suggested retail of \$450 its performance exceeds that of \$600.00, \$1200.00 and even more expensive units that have passed through our laboratories. One nagging question remains, however: with tuners such as the Sansui TU-9900 now available at such reasonable cost, what stations are users going to be able to tune to in order to really realize just how good the FM reception from these products can really be? What you will hear when using a Sansui TU-9900 will in every case, be limited by transmission practices and signal quality from your own local FM stations. Sadly, in most cases, that just isn't good enough to show off this tuner to its best advantage. You can, of course, apply lobbying pressure to your favorite stations to clean things up—or you can invest in a Sansui TU-9900 now and hope that station practices will get better someday in the future.</p>	

are definitely a function of the broadcast signal and not the tuner. We were, of course, careful to reduce multipath interference to an absolute minimum in judging the listenability of this product and used a scope for this purpose in addition to the built-in multipath indicator. Our summary comments and overall product evaluation concerning this elegantly executed stereo tuner will be found in Table II. In addition to its being a top performing tuner for use with the most sophisticated "separate" high-fidelity compo-

nent system in anyone's home, may we humbly suggest that some of the FM radio stations in our area (and yours) purchase one of these wonders as a station monitor. Perhaps many of them have been blaming their monitoring tuners or receivers for the poor quality they've been hearing. Given the capabilities of the Sansui *TU-9900*, perhaps they will realize that the trouble may lie elsewhere and will do something to bring us the kind of FM reception that this tuner is capable. **R-E**

### BATTERY REFERENCE BOOK?

*Do you know of a good book dealing with batteries? I need something that covers all types.—M.J.W., Mt. Dora, FL.*

The reference nook I use most often is Union Carbide's "Eveready Battery Applications Engineering Data", put out by Union Carbide Corp., Consumer Products Div., 270 Park Ave., New York, NY 10017. This is available in many radio-TV supply houses. I'm sure that there are several others from the larger battery makers.

The March 1976 issue of IEEE Spectrum has a very good article dealing with all types of batteries. You may find this in the library.

### VERTICAL SYNC PROBLEM!

You won't believe this! I wrote you in December 1974 about a vertical sync problem with a Magnavox U99. You gave me some ideas (none of which helped) but it was crazy. With the back off, the sync was OK; back on, no sync. Change the tube, integrator, etc., etc.—no help. Finally dawned on me. With the back off I was hooking the antenna to the insulation of the lead-in to the tuner. Now I could make it roll with the back off by hooking to the ends of the line.

Checked all capacitors; good. Changed all capacitors. Nothing. Once in a while the picture would go very snowy.

Changed the 2DZ4 and cleared that up. Still had no vertical sync! Finally, in desperation, I changed the 1N82 mixer diode. THAT DID IT! Putting the old one back in, you could see the vertical sync disappear on the scope! New one, fine sync!—Glenn Schaefer, Schaefer TV, Peoria, IL.

### NO CATHODE VOLTAGE

*After replacing the flyback in this Philco 21L23, nothing works! Used exact replacement transformer and I've changed all of the tubes. No raster, no high-voltage. Boost voltage reads only +87 volts. The damper cathode reads zero, so I know it's not conducting. Have you got any fresh ideas?—R.B. Santa Ana, CA.*

Fresh ideas? At my age? Hmm. However, I can see something decidedly wrong here! You read zero on the damper cathode. You *must* have the full DC supply voltage at this point, even though the horizontal sweep section is not operating. Reason: every bit of the current used in this whole section flows *through* the damper tube!

This doesn't seem to be a short circuit, for this would trip the breaker. So, something is open. I have seen this happen before. In one set, the damper cathode ribbon was broken. Since you've tried new tubes (right!) that should be OK. Look for something like a broken connection. **R-E**

# MIND POWER: ALPHA

**Part IV. Build this biofeedback device that displays the presence of alpha waves on a TV screen. You can use it to learn how to control your alpha waves, and gain from the benefit of the relaxation that comes with it**

BIOFEEDBACK IS ONE OF THE IMPORTANT METHODS THAT SCIENCE has unearthed to help us relax. The principle is simple: provide a way for the brain to sense that it is successfully gaining control over sources of stress, and control will become a new, normal function. Thus, just as your brain can learn to read, understand a foreign language, play a chess game, etc., so too can it learn to reduce tension and stress.

During the state of relaxation and tranquility, brainwaves show a dominant *alphawave rhythm*. To detect these alpha-waves, an outside instrument is needed. That instrument is Mindpower: Alpha.

Mindpower: Alpha is a unique new biofeedback instrument that serves as a link between your mind and a visible, controllable display on your television set's screen. It aids you to train your mind to come down from a high-tension state of anxiety and stress, to a state of relaxation and stress-relief. This *alpha* state—the subject of intense interest among physicians, meditators, yogis, mind control groups and scientific researchers—has been shown to be beneficial to the body as well as to the mind.

In the preceding three parts of this article, the design, components, and assembly of Mindpower: Alpha have been described in detail. This month's concluding part of the article will describe how to connect Mindpower: Alpha to your television set, the initial set-up procedures and how to use Mindpower: Alpha to gain control over your alphawaves.

## Hookup

The composite video output signal from the Mindpower: Alpha video-driver can enter the TV set by either of two ways: *direct connection* to the video amplifier stage of the TV set; or, injection via a modulated RF-oscillator connected between the video output of Mindpower: Alpha and the antenna input terminals of your TV set. The modulated RF-oscillator is the type commonly used and sold to connect a television camera to a TV set for closed-circuit use. Such an oscillator generates a very low-power TV signal on a selected TV-channel that is then tuned-in as a broadcast TV signal would be.

Although not offered for sale by National Mentor Corporation, a modulated RF-oscillator that is compatible with Mindpower: Alpha's video levels is the *Pixie-Verte*, model PXV-2A, available in kit form at \$8.50 postpaid from ATV Research, 13th and Broadway, Dakota City, NE 68731. Instructions for assembly and use accompany the *Pixie-Verte*.

**Note:** The combination of Mindpower: Alpha and any modulated RF-oscillator may be construed to be a

## NOTE

**Mindpower: Alpha is an intriguing device for entertainment and experimentation in video bio-feedback. It is not a therapeutic instrument, neither is it suggested as a cure for individuals suffering from psychological or physiological disorders.**

*Class-I Video Device*, within the meaning of Part 15 of FCC Rules and Regulations. The FCC may require certification of such a combination and can impose penalties for willful, malicious or harmful interference. Moreover, it is against FCC regulations to sell such a combination unless properly certified. Users of such combinations are advised to familiarize themselves with the relevant portions of Part 15 so as to ensure compliance with present standards and requirements.

## Direct Connection

If you choose, instead, to connect your Mindpower: Alpha directly to your TV set's video amplifier, be sure to take safety into consideration. First, determine what kind of power supply your TV operates from. If it is an AC-DC set, it lacks a power transformer. This means that one side of the power line connects directly to the chassis of the TV set, making it "hot" with respect to ground. **Connection to a set of this type is hazardous and is not recommended.** The danger, here, is that the shield of the video cable may bring the "hot" chassis potential of the TV set out to the otherwise safe, transformer-operated section of the Mindpower: Alpha printed-circuit board. Your TV set should have a power transformer-isolated power supply for complete safety in operation. If it does not, locate one that does or purchase an external isolation transformer and use it to operate your TV set.

Second, be aware that hazardous-level voltages are present inside any TV set. It is possible to receive a severe shock from the circuitry, even with power-off due to storage of potentials in power supply capacitors and the second-anode capacitance of the picture tube. If you are unfamiliar with the locations of hazardous voltages within your set, have a qualified TV service technician make the connection for you.

Third, locate the input to the video amplifier section of your TV set. To do this, you should have the schematic diagram of your TV set. As an aid in locating the correct connection

point, Figs. 1 and 2 show typical vacuum tube and transistor-type video amplifier stages used in most TV sets. Yours will probably be a variation of either circuit. The connection point will be the input to the video amplifier where the video detector connects.

While the video output level of Mindpower: Alpha is just right for most TV sets, it may be too high for some. If necessary, you can reduce the video output to a lower level by

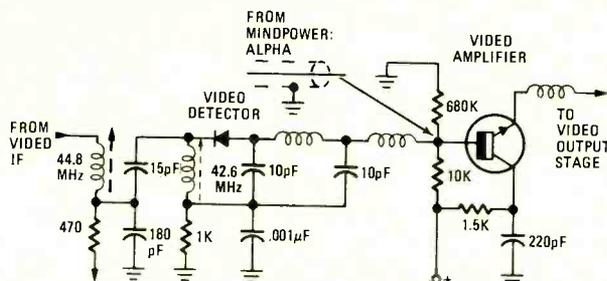


FIG. 1—TYPICAL TRANSISTOR VIDEO AMPLIFIER stage showing the connection point of Mindpower: Alpha.

use of a simple resistive divider. (The resistor values to be used depend upon the circuit values in the video amplifier of your TV set.)

### Final check

With the TV set on, plug in Mindpower: Alpha and set its MODE switch to the 1 position. (Turn off the BATTERY switch to prevent stray pickup from the electrode circuit from affecting the display.) At this point, you may see the display on the screen, although you probably will have to adjust the horizontal hold control of your TV set slightly to account for the 390-Hz difference between Mindpower: Alpha's horizontal frequency (15.36 kHz) and the 15.75 kHz horizontal frequency of a standard U.S. television broadcast signal. When this simple adjustment has been made, the image should stabilize and the TV screen should now be displaying a stationary white "hollow" rectangle against a dark field. Turn down the TV's brightness control to darken the field. Turn up the contrast control to increase the "whiteness" of the rectangle while improving the "blackness" of the field. Avoid excess contrast that makes the display seem harsh. Find a combination of settings at which the display seems visually comfortable to you.

Next, set the ALPHA switch to the TEST position. Note that the display shrinks to the center of the screen and blinks at the alpha test oscillator's rate. If you'd like to hear this, set the BEEP switch to the ON position.

If you don't obtain the results specified, re-check your connections and be sure that you've properly chosen the video amplifier connection point in your set. If the display won't stay in sync. or tears, you are probably overloading the video amplifier with signal, and a resistive divider will be needed to reduce the signal level. (Alternatively, you may wish to reduce the value of resistor R91 to lower the video signal output of driver Q12.)

### Using Mindpower: Alpha

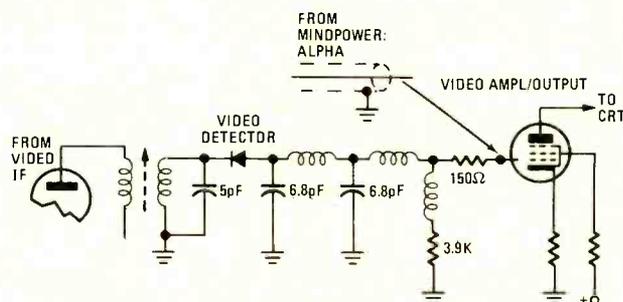
**Note:** Mindpower: Alpha is intended for use by normal individuals, as a device for entertainment and experimentation in video biofeedback. Persons suffering from epilepsy, or mental or physical disorders of any kind, should use Mindpower: Alpha only under the supervision of a physician. No therapeutic claims are made for this device, nor that each and every individual who uses the device will benefit from such use. National Mentor Corporation assumes no liability whatsoever with respect to the assembly, installation, use or misuse of this device.

To apply the electrodes, hold the headband so that the two

frontal electrode-buttons are closest to your right hand; the buttons should be facing toward you. Place the buttons against your forehead (comb back your hair first so that no hair gets trapped between button and skin to cause erratic contact), then wrap the band around your head about as snugly as you can comfortably stand. The prongs of the occipital electrode should comb through the hair at the back of the skull, and you should feel them contact the skin, below. If there is any sensation of discomfort, at first, it will pass within a minute or so as your skin sensors become accustomed to the headband and electrodes.

Turn on the TV and plug in the Mindpower: Alpha power transformer. Now, turn on the EEG front-end by setting the BATTERY and BEEP switches to the ON positions. With electrodes positioned as described above, gradually turn the THRESHOLD control clockwise. If you've barely turned it and hear a raspy, buzzing note from the speaker, plus a display that shrinks to nothing or even vanishes from the screen, you're not seeing alpha but you are seeing stray 60-Hz pickup caused by poor electrode contact. Check that there is no hair interfering between the electrodes and skin. Also, that there is no skin lotion, cream or make-up on the skin where electrodes are contacting. Wash the skin and clean the electrodes, if necessary, and try again.

Assuming, however, that you *don't* have a problem, advance the THRESHOLD control about a third of its rotation and blink your eyes. At some point, you will hear a "beep" and see the display shrink slightly in response to your eye blink. The blink response shows that gain is close to the



NOTE: IF DESIRED, A PLUG AND SOCKET MAY BE USED SO THAT MINDPOWER: ALPHA CAN BE DISCONNECTED FROM THE TV SET.

FIG. 2—TYPICAL TUBE-TYPE VIDEO AMPLIFIER STAGE. Mindpower: Alpha is connected between video amplifier and video detector.

correct setting. You are now picking up bioelectric signals from the occipital region of the brain, where visual signals are "projected" on the surface of the brain's cortex. Advance the THRESHOLD control a bit further and you may notice occasional beeps and response of the video image. You are now catching occasional alpha bursts that may be originating in any region of the brain between the right frontal electrode and the left occipital electrode. Advancing the control further, you may start to pick up 60-Hz interference, and you should now back off slightly on the control until the device responds only occasionally to bursts and is otherwise quiet. Note the setting of the THRESHOLD control for future reference.

To give yourself with a reference as to what strong, sustained alpha looks and sounds like, move the ALPHA switch to TEST. You should hear a rhythmic beeping and observe that the display shrinks to screen center and flickers at the beep rate. Slide the ALPHA switch back to NORM and you're ready to begin experimenting.

### Progressive stages of training

Despite the temptation you may feel to rush ahead *now* and try controlling the TV display with your brainwaves, you may be in for a disappointment if you do. As in all learning processes, the power to learn increases with each thing we

learn. And so, Mindpower: Alpha is designed to help you progress through five learning stages; each strengthening your capacity to handle the next stage.

First, turn off the TV set and the BATTERY switch on Mindpower: Alpha. If possible, darken the room you're in to dimly lit state. Choose a comfortable chair to rest in and place a stool or hassock beneath your legs so that you can relax your leg muscles. Leave the headband electrodes on so that you will remain accustomed to the gentle pressure of the band. Settle back in your chair, trying to make yourself as comfortable as possible. You may want to place a cushion or pillow behind your shoulders and neck so that you don't press the occipital electrode uncomfortably against the head. Loosen or remove any tight articles of clothing that make their presence felt. As much as you can, try to eliminate distracting sensations. Now, commence this simple relaxation exercise.



HEADBAND shown properly positioned on users head.

Think of the word RELAX. It has five letters. Breathe in deeply and think of the letter R. Now, exhale slowly visualizing the letter R in your mind. Repeat the sound of the letter R to yourself three times, silently. Remain quiet and breathe regularly. Now, breathe in deeply and think of the letter E, and exhale slowly visualizing the letter E in your mind. Repeat the sound of the letter E to yourself three times, silently. Remain quiet and breathe regularly. Repeat this procedure for the letters L, A and X.

Your body and your mind should now be relaxed and alert, ready to try the first of the five learning stages.

**Stage 1.** Set the BATTERY switch to ON and note the beeper's response to your present comfortable state of mind and body. Settle back with your eyes closed and recall the pleasant relaxation sensations of a few minutes earlier. Let your mind drift, daydream if you wish. It doesn't matter about what, so long as you don't focus intently on some detail or problem. (Doing so will immediately shift your mind into beta, causing cessation of alpha.) As you mentally drift you will hear the beeper occasionally, signifying alpha occurrence in bursts. As time passes, the bursts will grow longer and more frequent. (This may happen within the first session, or, it may take several hours, spread over many twenty-minute sessions.) When alpha is occurring, try opening your eyes and note if the beeper's response stops abruptly or diminishes to random bursts. In most cases, opening the eyes will cause cessation of alpha. Close your eyes again and try to regain the alpha state. When it occurs note the mental state and physical sensations you feel when the beeper sounds. With practice you should be able to learn the mental and physical states that bring on the greatest alpha response. When you have achieved this, you're ready for Stage 2.

**Stage 2.** The setup is the same as for Stage 1. With your eyes closed, try to recall the mental and physical sensations that

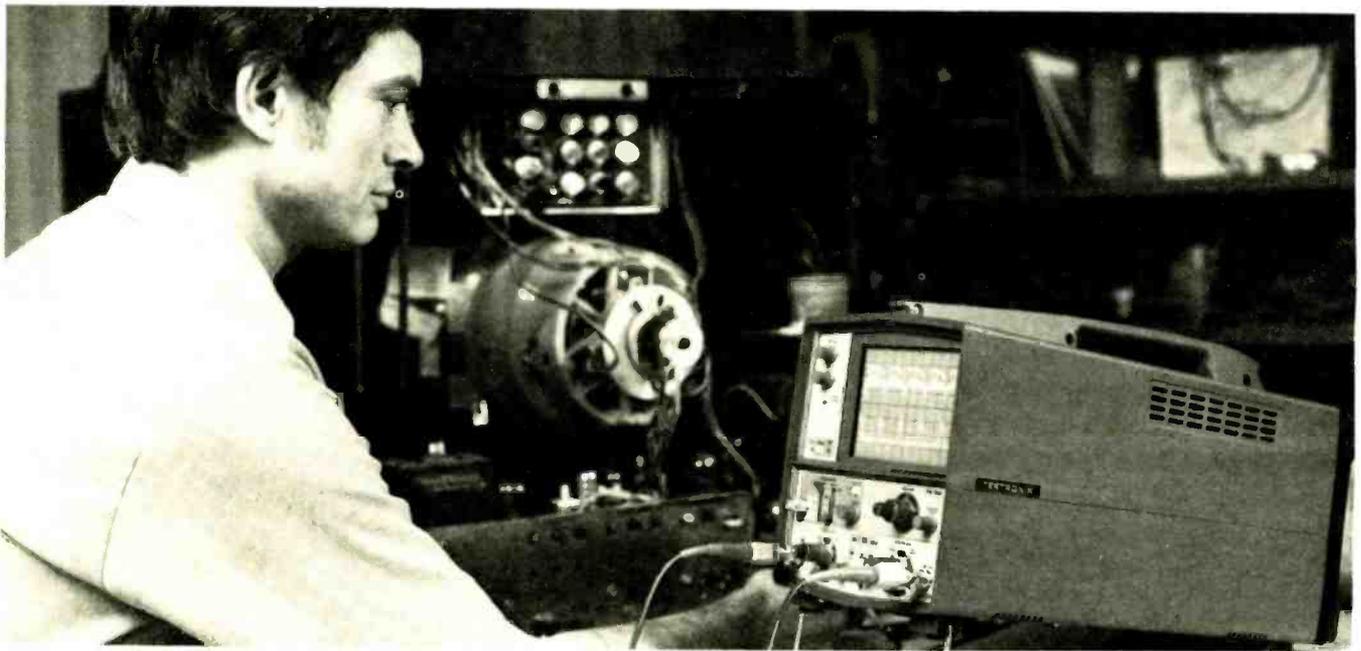
brought on the greatest alpha response in Stage 1. If you have difficulty in achieving alpha, try the R-E-L-A-X method to help you settle down. When alpha is occurring, reinforce yourself by noting your mental and physical state. Settle down again into alpha, and now try opening your eyes. If alpha ceases, try regaining it with your eyes open by recalling the mental and physical states that brought greatest response in Stage 1. (Generally, keep your eyes fixed on a point, while letting your attention drift.) With practice, you should be able to generate alpha with your eyes open, and you should be able to associate your mental and physical states with prolonged alpha generation. The time required to reach this state will vary. But, when you've obtained alpha with your eyes open, you are ready for Stage 3.

**Stage 3.** The setup is much the same as for Stages 1 and 2, except that the TV set is now on and the Mindpower: Alpha unit's MODE switch is set to 1. Begin with your eyes closed, working with the beeper to get into sustained alpha. Open your eyes and try to regain the eyes-open alpha you learned in Stage 2. Now, commence watching the Mode 1 video display on the TV screen. Slide into alpha again, noting what happens when the display shrinks in reaction to your alpha. If the shrink reaction causes cessation of alpha, try to regain the mental and physical sensations you learned in Stages 1 and 2. This should restore alpha each time it is "blocked" by the display's movement. With time and practice, the "blocking" reaction should be extinguished. Gradually, your alpha should become sustained and you will find the rectangle shrinking to a smaller and smaller size and remaining so for longer periods. When you've reached this point, move on to Stage 4.

**Stage 4.** You are now ready to make the transition from audio feedback to video feedback. Set the BEEP switch to OFF and use Mode 1 video alone. Using the methods described earlier, get into a relaxed state and now attempt to recall the sensations that produced the greatest alpha response. As you now see the alpha response by the video display, you will realize that what your brain has previously learned through aural sensation has now been carried over into the visual sensory pathway. To increase the strength of your alpha, try reducing the THRESHOLD setting slightly so that it will be necessary to generate alpha waves of higher amplitude to secure response. With time and practice, you should see this increase occur. You are then ready to move on to Stage 5.

**Stage 5.** In this stage, we add the dimension of movement to the video display. We live in a world of moving visual-stimulus, and so it is another training step toward relaxing in the real world to learn how to generate alpha when confronted by a dynamic visual sensation. Commencing as before, enter the alpha state. Now, set the MODE switch to 2 and let your eyes follow the periodic expanding display on the TV set screen. Recall the physical and mental states that yield peak alpha and observe how each burst arrests the rectangle's outward expansion. Your goal is simple: overcome the display's motion and hold the rectangle at a fixed size on the screen. Beyond this, you can try to back it down to a minimum size at screen center, completely preventing its outward motion. Both of these tasks are difficult because they require sustained high-amplitude alpha. It should be expected that considerable time may be required to master this stage. Once you have done so, however, you will have reached a new plateau of control over the brain-body matrix.

Perhaps the most fascinating results of your experience with Mindpower: Alpha will come from your day-to-day experiences in real-world situations. Your mind and body have now been trained to some extent to relate to one another in a new way. In the presence of a stressful situation, attempt to recall the mental and physical sensations associated with peak alpha. By doing so, you should be able to bring on a state of stress-reduction. The degree of success you experience in doing this will determine whether or not you need additional training in the earlier stages to achieve stronger results. R-E



# Delayed-Sweep Scopes—how and why

*Delayed-sweep oscilloscopes are gaining in popularity. Here's a description of what delayed-sweep does and how to use it*

**BILL GLAZE\***

DELAYED SWEEP, A METHOD OF MAGNIFYING selected portions of an oscilloscope trace, is now available even in some low-cost instruments. It might be just what you need to make faster and better scope measurements. The technique is particularly useful in working with complex waveforms, composite video signals for example.

A delayed sweep makes use of two traces, one or both of which may be displayed. One trace is used to present the larger waveform being studied. The second or delayed trace, running faster than the first, is used to produce a "close-up" of some desired portion of the signal.

## Triggering

The trigger circuit in a conventional oscilloscope starts each sweep of the trace at a preset input-signal level. Triggering can normally be adjusted for a particular input signal slope and level, or can be controlled externally.

Conventional triggering produces a flicker-free trace only if the trigger is set off by just one event in each waveform.

This can make it difficult to examine portions of a complex waveform in detail, since it may be hard to find a unique signal level close to the point of interest to trigger on.

With delayed sweep, the main ("A") channel of a delayed-sweep scope operates in the conventional trigger mode. The "B" channel can sometimes be operated similarly. But with delayed sweep, the B-channel triggering can also be delayed (set to trigger at a given time after the A-channel triggers). The length of time between the start of the A-channel sweep and the delayed B-channel sweep is called the delay time and is adjusted with the scope's delay control.

Thus, the A-channel sweep can be set on any clear trigger point in the signal, and the delayed sweep can be set to start at a specified time later, even if there is nothing in the signal itself to trigger a second trace.

Trigger holdoff is sometimes mentioned as a more inexpensive substitute for delayed sweep. This feature will do the job in a limited set of cases where the only triggering problem is too many

trigger points on a repetitive signal. The holdoff control simply blocks triggering for a settable time after normal retrace. Consequently, this method cannot be used when there is no clear signal close to the point of interest, the signal is not repetitive, or the interval involved cannot be synchronized—is shorter or longer than the holdoff period. For this reason, trigger holdoff, although useful in itself, is rarely an adequate replacement for delayed sweep. It is a good supplement and is often offered as a convenience on delayed sweep scopes.

## Operation

Suppose you are interested in viewing the central portion of the trace illustrated in Fig. 1-a. If you set a conventional scope to trigger at the slope and amplitude of the part of the wave you are interested in, it would also be triggered by several other portions of the wave and produce a flickering display. To avoid flickering, the scope must be set to trigger only on a unique peak in the signal. When triggering on the beginning of the waveform, you must use a relatively slow sweep rate to view

\* Tektronix, Inc., Beaverton, OR 97077

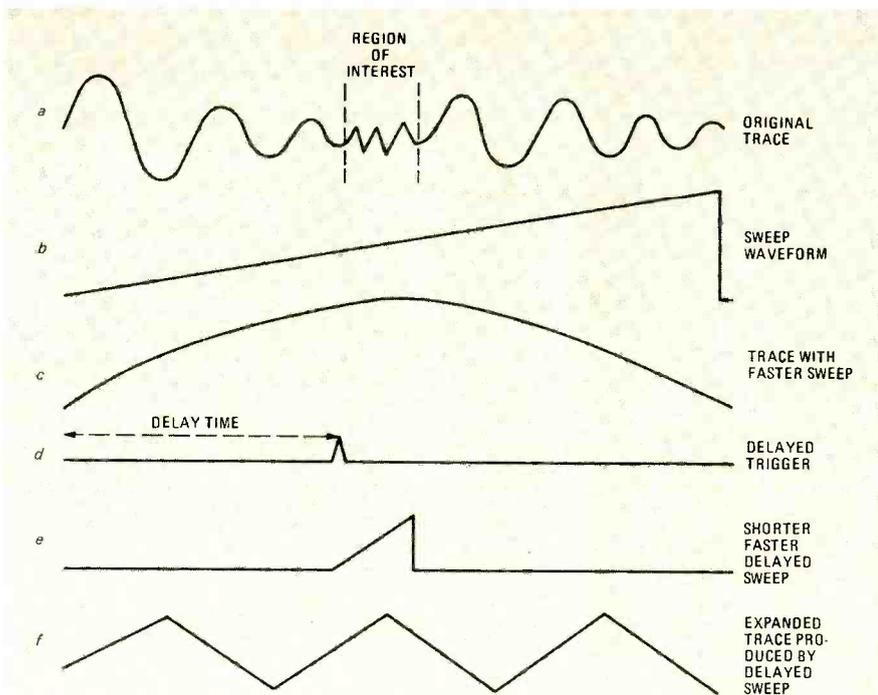


FIG. 1—DELAYED SWEEP WAVEFORM—how it is produced.

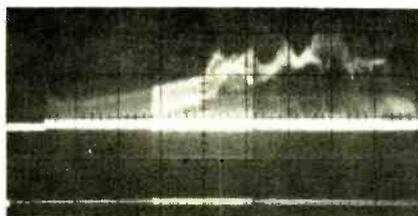


FIG. 2—FRAME OF COMPOSITE VIDEO showing how the intensified region on the delaying trace marks the area to be presented on the delayed trace.

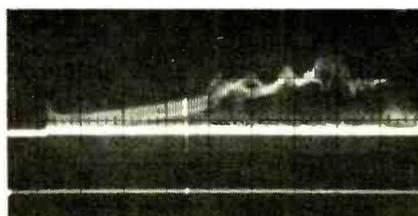


FIG. 3—A SINGLE LINE from a whole frame of composite video can be selected for display with delayed sweep.



FIG. 4—THE SINGLE VIDEO LINE. (All waveform photos made with the Tektronix T935 oscilloscope.)

the desired portion of the signal. (Figure 1-b shows the sweep waveform that a conventional scope would use.) A slow sweep-rate produces a trace that shows relatively little detail.

If you simply increased the sweep rate, you would only be able to see a small part of the signal in detail (Fig. 1-c) and in many cases you would miss the point of interest.

To view the wave with a delayed-sweep scope, you would first adjust the A-channel of the scope to give the best presentation of the wave you could get with conventional triggering. You would then adjust the delay time so that the B-channel does not trigger until just before the part of the signal you are interested in (Fig. 1-d). The timebase of the delayed sweep is independent of the main channel. By increasing the sweep rate of the B-channel (Fig. 1-e), the desired portion of the signal can be expanded to stretch the width of the screen.

The delayed sweep now shows a small, selected portion of the main trace (Fig. 1-f).

Some delayed-sweep scopes have

“displayed switching” capability, allowing you to choose between viewing the A-channel only, B-channel only, or both at the same time. Many scopes provide for intensifying the part of the main trace duplicated by the delayed trace. This makes it easier to adjust the delay control to show the desired portion of the trace.

### Magnification

The delayed trace, set on a faster timebase, effectively magnifies a portion of the main trace. The amount of magnification is equal to the sweep speed of the main trace, in time per division, divided by the sweep speed of the delayed trace expressed in the same units. For example, if the delaying sweep is set at 20 ms/div and the delayed sweep at 2 ms/div, the magnification will be 10 $\times$ . By speeding up the delayed sweep to 0.2 ms or 200 ms/div, one hundredth of the main trace is displayed at 100 $\times$  magnification.

At very high magnifications, on the order of 1000 $\times$ : the delayed trace may be somewhat jittery. Even small variations in the signal, or in the triggering or

delay of the main trace, will cause large displacements of the delayed trace. This difficulty can be overcome only by modifying the delayed channel trigger. On some more expensive scopes, instead of triggering automatically a set time after the maintrace triggers, the B-channel is merely enabled or armed after the delay time, and actually triggers on the input signal.

Using another technique, to allow further magnifications, some delayed-sweep scopes have a magnified mode. This allows the center portion of either or both traces to be magnified.

### Video signals

The usefulness of the delayed-sweep scope is obvious when working with a composite video signal. The basic signal is displayed as the main trace. The delayed sweep controls can then be set to determine how large a portion of this initial trace will be expanded the full width of the cathode-ray tube for more detailed viewing. If the delayed sweep is set ten times faster than the main sweep, then one tenth of the original waveform

will be expanded.

Choosing the portion of the main trace to be magnified is simplified if the scope can be set to intensify it automatically, as shown in Fig. 2. By adjusting the time delay, this brighter segment can be shifted left or right.

A further increase in the delayed sweep speed selects a shorter portion of the main waveform. Figure 3 shows a complete frame of a TV composite signal as the main trace, with one line to be magnified intensified. The chosen portion is so short, relative to the width of the main trace, that it appears as a single bright point. Fig. 4 shows the single TV horizontal line of picture information magnified and displayed as a delayed trace.

If the scope has a delayed-sweep magnifier feature, a portion of the delayed display can be further expanded. This could be used, for example, to expand the horizontal sync pulse (at the far right in the Fig. 4 display). A flicker-free, readable image of this signal showing as much detail would be impossible without delayed-sweep triggering.

R-E

# All about SWR and CB performance

ONE OF THE MOST POPULAR CB ACCESSORIES is the SWR meter, also known as the VSWR meter or VSWR bridge. The reason for the SWR meter's popularity, and the reason you should have one if you don't already own one, is that it quickly and easily indicates whether your antenna system is matched to your transmitter.

The SWR determines how much RF output the transmitter delivers to the line and how much of the energy fed into the line gets to the antenna. If the SWR is poor, very little of your transmitter's RF power will actually leave the rig.

Actually, SWR means *standing wave ratio*, and it is defined as the antenna's impedance divided by the transmission-line impedance, or vice versa. The exact arrangement of numbers isn't important as long as we end up with a whole number. For example, if the transmission line is 50 ohms and the antenna is 25 ohms, the SWR is  $50/25$  or 2:1. If the transmission line is 50 ohms and the antenna is 100 ohms, the SWR is  $100/50$ , or 2:1. The ideal SWR is 1:1 and occurs when the two impedances are equal.

## Impedance

Coaxial cable used for transmission lines has what is known as a characteristic impedance. This impedance is determined by the thickness and spacing of the wires and the dielectric that separates the center-conductor and shield.

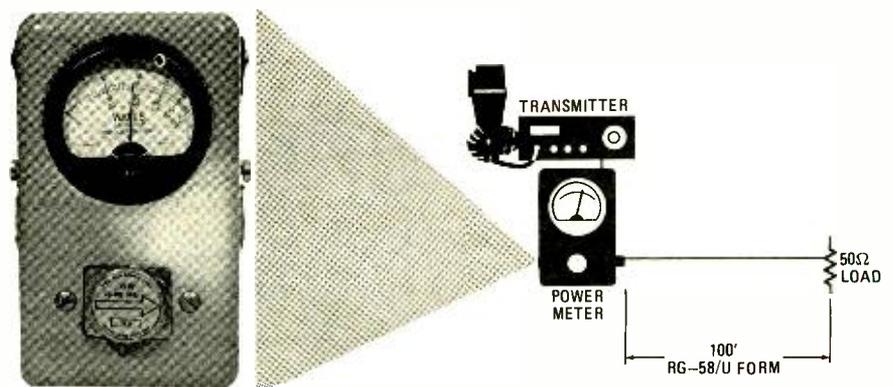
The antenna, at its resonant frequency, has a *resistive impedance*—which is something other than *radiation resistance* though the two are often confused as meaning the same thing. The resistive impedance of an antenna is anything we design it to be. In the case of *most* CB antennas, the *impedance* is designed or tuned for a nominal 50 ohms. In this case, the antenna's radiation resistance might actually be closer to 10 ohms.

Maximum power is transferred from the transmission line to the antenna when the antenna's resistive (resonant) impedance is equal to the transmission-line impedance. Assuming no other line losses, if a CB transmitter feeds 4-watts RF into the transmission line, 4-watts will flow out the other end and into the antenna. If you could measure the voltage and current at any point along the transmission line you would find

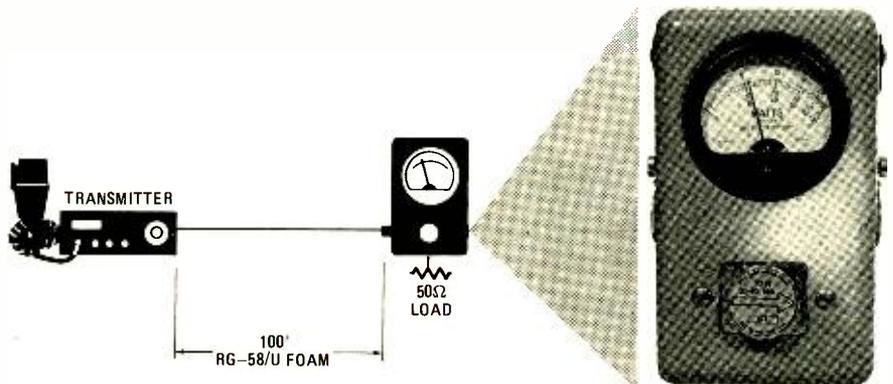
equal values all along the line.

When the antenna is not equal to the line impedance, part of the energy at the line's output does not flow into the antenna; it actually turns around and flows back to the transmitter. The RF that is turned back is termed *reflected power* and it is dissipated as heat in the

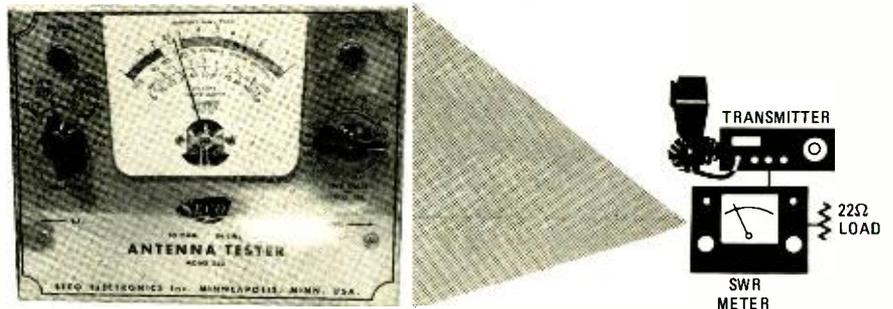
line and in the transmitter's output circuit. The amount of RF that is reflected is determined by the SWR—the mismatch between the antenna and line. Table 1 shows the effect of antenna/line mismatch for common SWR values. The table assumes the transmitter can deliver 4-watts into the



**POWER MEASUREMENT** at input to transmission line shows that the reference CB-transmitter used throughout the following tests delivers almost 3.7 watts of RF output.



**POWER MEASUREMENT** at the end of the 100-foot transmission line shows only 2.2 watts; 1.5 watts is lost as heat in the transmission line—a loss of 2.2 dB.



**SWR MEASUREMENT** with a 22-ohm load on a 50-ohm SWR meter indicates 2.7:1 instead of the calculated 2.27:1. The difference results from the meter acting as an ordinary transmission line and the meter does not "see" a pure resistance. It is not unusual for different SWR meters to produce slightly different readings.

Getting maximum performance from a CB rig means reducing the SWR to a minimum, but this can mean more than simply adjusting the antenna. Other factors, such as the length of the transmission line, play a major role

HERB FRIEDMAN

line under any condition, though as we'll show later this is rarely possible with CB gear.

Note that at almost perfect match—SWR of 1.2:1 or lower—most of what goes into the line eventually gets to the antenna. Even with an SWR of 1.5:1, 96% of the power fed into the transmission line gets to the antenna. It is only with an SWR of 2:1 that the power loss starts to be of concern. At 2:1, nearly a 1/2-watt of RF power is reflected and only 3.52 watts gets to the antenna. But

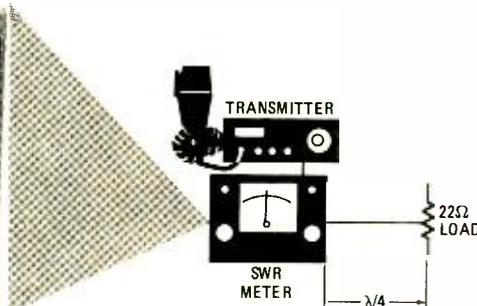
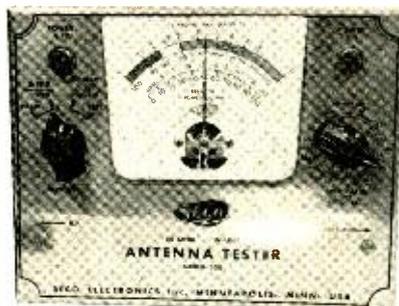
even this is not a great loss if there were no other losses in the antenna system, for the loss represents only 0.55 dB—really an insignificant loss when you consider 1 S-unit is accepted to represent 6 dB.

At SWR values from 3:1 upwards, however, the losses become severe and a substantial part of the RF energy fed into the line never makes it into the antenna. When the SWR reaches 8:1, a full 40% of the RF power is reflected back.

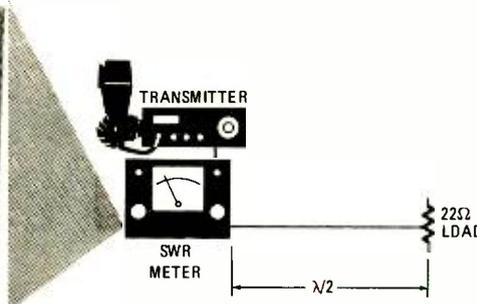
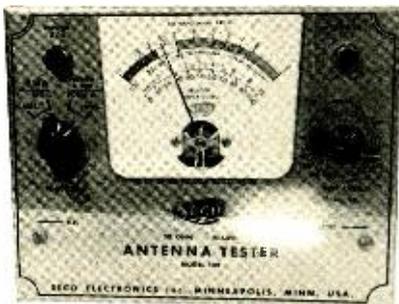
### Measuring SWR

The SWR of an antenna system can be measured in any number of ways. For the hobbyist, the easiest way to determine SWR is by using a *reflectometer*. This instrument measures the forward power (the power flowing from the transmitter to the antenna) in the transmission line and the reflected power (the power flowing from the antenna back to the transmitter). The magnitude of the SWR is the ratio of the forward power to the reflected power. The meter scale of the reflectometer is simply calibrated to read SWR.

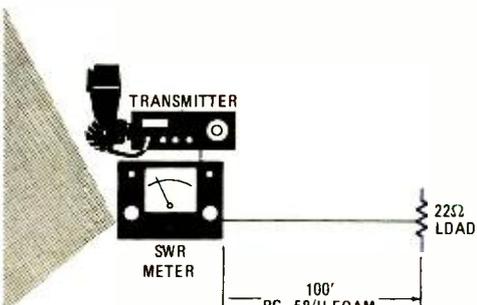
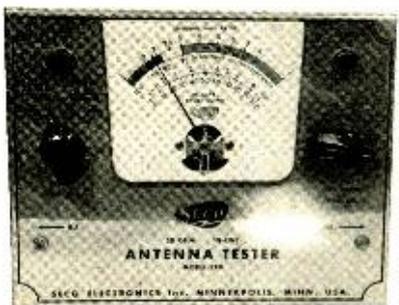
A simple low-cost reflectometer can be made from a few common components. A simplified circuit of a low-cost reflectometer is shown in Fig. 1. The RF voltage in the transmission line is induced in the sensing wire and rectified by a diode. The resulting DC voltage is



1/4-WAVELENGTH TRANSMISSION LINE connected between SWR meter and 22-ohm load raises the SWR reading to 4.3:1. The meter "sees" the input to the 1/4-wavelength matching section, which is a high impedance when the load is less than the characteristic impedance of the line.



ESSENTIALLY CORRECT SWR READING of 2.4:1 is obtained with a 1/2-wavelength line connected between the SWR meter and the load. The meter "sees" essentially the load because the 1/2-wavelength section acts as a load-repeater. The slight error is due to the meter's internal coax.



INCORRECT SWR READING of 1.7:1 is obtained using 100-foot of transmission line. The low reading results from the line-loss that reduces the reflected power.

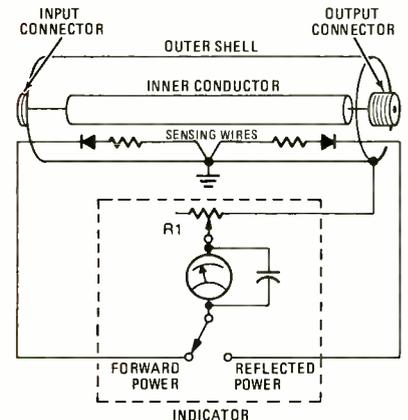


FIG. 1—SIMPLIFIED SWR METER. R1 is adjusted so meter indicates a full-scale reading for the forward power. Suitable calibrations indicate the reflected power in terms of SWR when S1 is switched.

proportional to the RF voltage in the transmission line. Since the impedance of the transmission line is constant, the DC voltage is also proportional to the RF power in the transmission line.

Two sensing wires and diodes are used. One combination senses the forward power and the other senses the reflected power. A switch is used to select between the two.

To use the reflectometer, the switch is first set for a forward power measurement and R1 is adjusted for a full-scale

reading on the meter. The switch is then changed to measure the reflected power and the SWR is read directly from the meter scale. In many CB rigs, this circuit is built on a small PC board allowing built-in SWR metering.

### Problems

If all a line/antenna mismatch meant was a loss in energy fed to the antenna there wouldn't be too much concern as long as the SWR was below 3:1, and in fact a 3:1 SWR is acceptable in mobile installations with short coax runs. It's the base installations, however, that really get socked by moderate SWR values, for SWR magnifies all other line losses as well as changing the apparent input impedance of the transmission line. Taking one thing at a time let's start with line losses.

All transmission lines have losses, there is no such thing as a lossless transmission line. Ordinary RG-58/U coax cable has a loss of 2-dB to 3-dB per 100-feet at around 27 MHz. For the sake of discussion let's assume you were stuck with a 3-dB loss in a 100-foot run between your transceiver and the antenna. If all you had to contend with was the normal 3-dB line-loss and the SWR (reflected power) loss was 25% (3:1 SWR) of the 4-watts fed into the line, only 1.5 watts would be fed into the antenna. No, don't shake your head, this is a common base situation and if you think a 3:1 SWR is unusual you have another guess coming (which we'll get to later).

Now note that we have allowed only for the normal line and SWR losses. During actual operation, the SWR has a multiplier effect on normal line loss. A 3:1 SWR on a transmission line with a normal 3-dB loss adds 1-dB more to the overall loss in the line. So, of the 4-watts fed into the transmission line under best-case conditions, only 1.2-watts gets into the antenna.

Or is it 1.2-watts? An SWR meter is really a forward/reflected power meter with a control that permits the user to calibrate the forward power to represent full scale. Keeping this in mind, let's look at the 3:1 SWR on the antenna system with 100-feet of coax transmission line. If the SWR meter and transceiver were connected directly at the input to the antenna, the meter would "see" 4-watts forward power and 1 watt (25%) reflected power. But in normal use the SWR meter is at the input to the transmission line—close to the transmitter's output where it "sees" 4-watts fed into the line. The 4-watts travels down the line and the actual 4-dB loss (3-dB line loss plus 1-dB loss due to the SWR) allows only 1.6-watts to come out. The antenna mismatch turns back 25% of the 1.6-watts, or 0.4-watts. The 0.4-watts that is reflected back down the line under the best-case condition will be

**TABLE 1—EFFECT OF SWR (line to antenna mismatch) assuming the CB transmitter delivers 4-watts RF output into a lossless transmission line.**

SWR	Percent power reflected at antenna	Watts fed into antenna
1:1	0.00	4
1.05:1	0.06	3.997
1.1:1	0.22	3.991
1.2:1	0.82	3.96
1.5:1	4.00	3.84
2:1	12.00	3.52
2.5:1	18.00	3.28
3:1	25.00	3.00
4:1	36.00	2.56
5:1	44.00	2.24
8:1	60.00	1.6

attenuated by the normal line-loss of 3 dB, so only 0.2-watts gets back to the SWR meter at the input to the line. The SWR meter knows nothing of line losses: it simply "sees" 4-watts forward power and 0.2-watts reflected power. As far as the meter is concerned, these values represent an SWR of about 1.6:1. So that's what the meter indicates, an SWR of 1.6:1—which is pretty good in anyone's book until you realize the actual SWR is 3:1.

Again, the foregoing analysis is true if we consider everything being theoretically correct; unfortunately there is another *zinger* waiting for the unsuspecting.

CB transceivers are designed and factory-tuned for a 50-ohm resistive load, the antenna impedance at resonance. When there is a mismatch between the line and the antenna, the input to the line appears resistive only when the length of the line is an *electrical* quarter wavelength, or its multiple. (To keep this short and simple just assume the antenna characteristic is entirely resistive; let's not get involved in non-resonant antennas.) If the length of the line is a quarter wavelength or an *odd multiple*, the line acts as an *impedance inverter* with the input/output impedance hinged at the line's characteristic impedance. Assuming the line is 50 ohms, if the load is less than 50 ohms the input impedance to the line is greater than 50 ohms. If the load is greater than 50 ohms, the input to the line appears as an impedance of less than 50 ohms. For example, if the load is 25 ohms (2:1 SWR) the input impedance of the line is 100 ohms.

At other than one-quarter wavelengths, if the line length is shorter or longer than one-quarter wavelength, or its multiple, the input to the line will have a resistive and reactive component that can be well beyond the range of values that a modern solid-state CB transceiver can load efficiently. Fact is, connecting a 100-ohm load to most CB transceivers with a 4-watt output capability might result in as little as 1-watt output.

A half-wavelength transmission line

(or multiple) acts as a *repeater* or *1:1 matching transformer* in that the input to the line repeats exactly what appears at the load end. If there's a 25-ohm load at the end of the line, the input to the line appears as 25 ohms. Most solid-state rigs work better into lower rather than higher impedances, and so will put out more power into 25 ohms than it will into 100 ohms.

Some of the new low-pass filter RF-output circuits will deliver greater RF output into a load of less than 50 ohms. Unfortunately, when the RF output is increased without an increase in modulator power to maintain the same modulation level, the *readability* of the signal at the receiving end is sharply reduced. Also, the power output transistor heat dissipation rises sharply, and the life expectancy of the RF output-transistors might drop to a few months.

No matter how we look at it, an unusually high SWR *usually* prevents the transmitter from delivering its maximum available power, and in most instances the loss in transmitter output generally exceeds the SWR loss. This can be compensated with a *matching device* that makes the input to the transmission line appear as 50 ohms. An SWR meter connected between the transmitter and matcher will indicate 1:1 when the matcher is properly adjusted, and the transmitter will deliver its total available output because it sees a 50 ohm load—the design value. But make no mistake, all the SWR and line-losses that previously existed still exist between the matcher and the antenna. If you had two SWR meters, one in front of the matcher and one after, the one in front would indicate 1:1 and the one after the matcher would indicate the antenna system SWR reading, plus or minus some small change because of the added transmission line between matcher and transmitter. (The transmission line length is the *total* length from the transmitter's output circuit—inside the cabinet—to the antenna.)

If at this point you get the feeling SWR and its effects is some slippery evil

*continued on page 114*

# THERE IS NO QUESTION

## Our computer is a bore—

There is simply no point in trying to hide it, everyone is going to find out sooner or later anyway. The Southwest Technical Products 6800 computer is a big bore. Discussions with customers and dealers have confirmed our worst suspicions.

At first people thought that perhaps owners of our system were just a bit shy because they were outnumbered at local computer club meetings. But then as the number of owners rose it became clear that this was not the problem. And it wasn't that they were unsociable or anything like that; they were simply just bored because they had nothing to talk about.

Here they were, just sitting there while all the other members with other brands of computers exchanged data on circuit board errors, secret schemes of adding extra bypass capacitors to make the thing reliable, tricks to keep the clock phases from overlapping, corrections to manual errors and other fun subjects. Can you imagine the frustration this caused? All our customers could do was to sit and be bored. They had nothing to talk about.

Our 6800 has an internal monitor ROM that automatically puts the bootstrap loader in memory and refers control to the terminal, when you power up. This feature deprives you of the chance to tell sad stories of how many

times you had to go back and flip the console switches before you got the loader program in right. Since you can do machine language programs directly from your video terminal or teletype in hexadecimal form, you will not have a chance to exchange horror stories with your friends about how you forgot the last zero when you entered 10100110 from the console on your 374th Byte and messed up the program that had just taken you two hours to put into memory. It just isn't fair.

Since we use full buffering on all data, address and control lines on all boards in our system and since we use low power 2102 static memories in our system, there are no noise sensitivity problems that can lead to hours of fun trying to figure out why a program "bombed". Dynamic memories that some others use can drop bits, fail to refresh random cells, cause programs to do crazy things by going into a refresh cycle at the wrong moment and all kinds of interesting things. Our poor customers will never have a chance to have these interesting experiences.

Even our documentation and software is no help. Not only do we have the most complete and thorough set of instructions available for any system, we are supplying software either free, or at crazy low prices. Our big documentation notebook for instance

is just full of information on the system. There are complete sections on software with sample programs and information on programming. We have no assembly instructions in that big yellow notebook. They are packed with the kits themselves. The notebook is completely devoted to instruction on using your computer system. You are therefore not going to be spending day after jolly day trying to find out how to put a program into your machine; researching all available outside literature in an attempt to discover just how you write software for the beast. Sorry about that folks, we didn't mean to spoil all your fun.

So please, have a heart, when you see those poor lonely souls that have purchased our systems say "hello". All they have to keep them interested in computers is writing and running programs. Our editor, assembler, 4K and 8K BASIC programs work so well that even this is quick and easy. So be kind to those poor bored SwTPC-6800 owners, it's not their fault that they have nothing to talk about.

**SWTP 6800**  
Computer System

with serial interface and 2,048 words of memory. . . . . \$395.00



- I don't like puzzles anyway and have no free time to be bored so send information on your 6800 computer system and peripherals.
- Thanks for warning me. Send names of manufacturers of "interesting" computers.

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_

Southwest Technical Products Corp., Box 32040, San Antonio, Texas 78284

CIRCLE 76 ON FREE INFORMATION CARD

# R-E's Service Clinic

## Stacked transistor IF stages

*An odd circuit made easy*

**JACK DARR**  
SERVICE EDITOR

A LONG TIME AGO THERE APPEARED AN ODD circuit in TV sets. The circuit had two identical tubes connected in a cascade configuration. The DC voltage supply was applied to the plate of the second tube. The cathode of the second tube was connected to the plate of the first tube and the cathode of the first tube went to ground. So, the DC voltage was divided equally between the two tubes. The signals were fed through bypass and coupling capacitors for isolation. A common supply voltage was +300, so +150 volts appeared across each tube. This was called a stacked IF circuit. Other and much less printable names were heard on occasion. For a while, it was quite common in IF stages. (Actually, I don't know why they fed the high voltage to the second tube. They did, though. Could have gone to the first just as well. No matter.)

tuned transformers and traps to the 1st IF transistor. Then through another tuned circuit, with a coupling capacitor to the 2nd IF transistor. Finally on to the 3rd IF, which is completely isolated from the first two for DC only.

Let's lift the stacked circuit out and see what the difference is. Figure 2 shows it with the DC supply path *only*. All bypass and coupling capacitors have been left out. We start with a +80 volt DC supply. There is a 1 volt drop across the low resistance of the collector coil. The base is clamped by an elaborate voltage divider network from the +80 volts through four resistors to ground. This same network also clamps the base of the 1st IF transistor. A small thermistor is used for stabilization.

Now we get back to the DC path through the two transistors. The path is through the coil, 2nd IF transistor, 1st

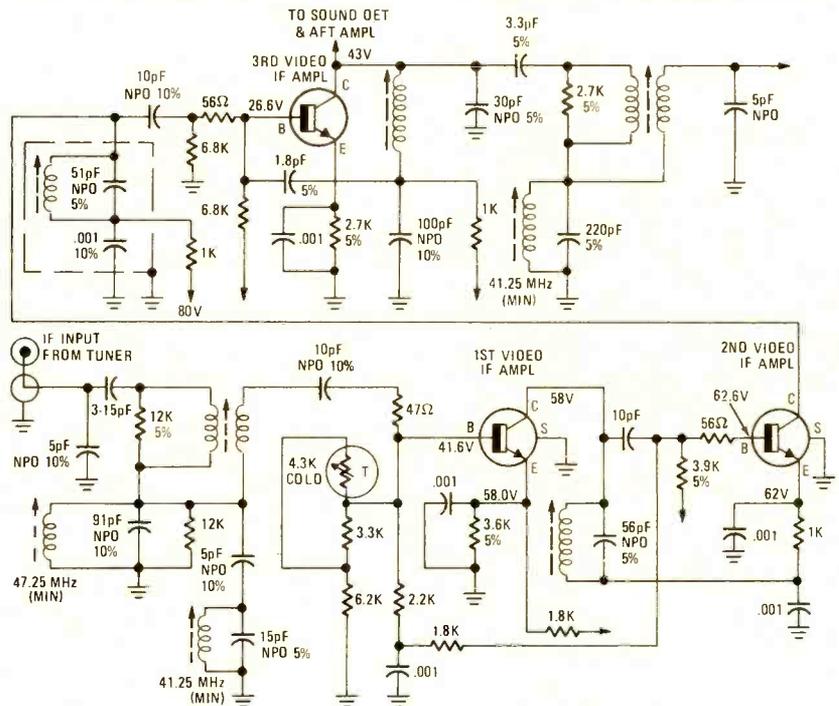


FIG. 1

Now, it's showing up again in quite a few popular TV sets, both color and black-and-white, using transistor IF stages. Figure 1 shows a typical stacked transistor IF as used in RCA's CTC-38 series. Note that the signal path is quite normal. From the input through the

IF transistor, and then through a comparatively large resistor to ground. The AGC voltage is fed to the emitter of the 1st IF transistor.

### Troubleshooting

If you find troubles in the IF that has

### REPLY COUPON

Expires 11/30/76

This column is for your service problems—TV, radio, audio or general and industrial electronics. We answer all questions individually by mail, free of charge and the more interesting ones will be printed here.

If you're really stuck, write us. We'll do our best to help you. *This coupon must accompany all questions. No reproductions or facsimile will be accepted.* Don't forget to enclose a stamped, self-addressed envelope. If return postage is not included, we cannot process your question. Write: Service Editor, Radio-Electronics, 200 Park Ave. South, N.Y. 10003.

such a circuit, the DC voltages can give you a good idea as to what's going on. As usual, this column was inspired by quite a bit of mail from readers who were having problems with it. In one of the latest, the reader found the DC voltage readings as shown in the balloons alongside the normal voltage readings (Fig. 2.) Here, you can see several things. For one very good possibility, Q1 is very likely shorted. Note the same voltage on all three terminals of Q1.

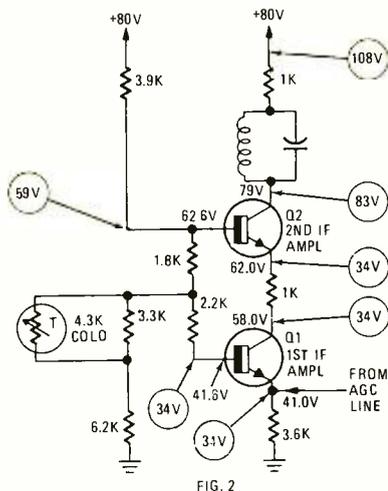


FIG. 2

This, of course, is upsetting the 2nd IF stage. The transistor has a normal

base-emitter voltage of only +0.6 volt—+62.6–62.0=+0.6 V. This is a very important point! The DC voltages on any of these transistors are *always* read from the transistor's own emitter, never from ground. The fault checks out as a base-emitter voltage of +25 volts for Q2. This should turn this transistor on and make it conduct very heavily. Yet, its collector voltage as well as the supply voltage are both very high. So, a very likely possibility here would be that Q2 is open, and Q1 shorted.

To make sure of this, you will probably have to take out at least one of these transistors. The short in Q1 could be confirmed with an ohmmeter, of course. After the transistors have been taken out, it would be a good idea to make a careful check of every resistor in this circuit. They're all critical, most of them are 5% tolerance types.

For replacement transistors, it would be a good idea to use the exact duplicate types. Note that the voltage on the 1st IF transistor is determined by the conduction of the 2nd IF transistor. So, if you got a little too quick in grabbing up a replacement transistor, you might get one with a lot higher or lower beta than the original. This will show up as a good sized difference in the DC voltage distribution. Since the bases of both transistors have their own separate

clamp network, these voltages will probably stay in the ballpark. If the collector and emitter voltages are off, you should try different transistors until you find a set that will get you back to the original DC voltages.

Another reader wrote in about this problem. After some correspondence, he finally said that he had to use the original RCA replacement types, and this cleared up the problem. In this chassis, both of these are the same type, RCA No. 124757. No general-purpose replacements are listed. Even the RCA SK Guide doesn't show them, nor do any of the rest. So, this is evidently the exception that proves the rule. The rule being what I have said on many occasions in the past, that transistors aren't all that critical! I *have* substituted general-purpose transistors in conventional common-emitter IF circuits without affecting the response curve, etc. In this kind of circuit, substitution of transistors with a different beta could definitely lead to an upset of the DC voltages and a drastic change in the response of the circuit. (Up till now, I had not thought of running an actual test of this, but you can bet I will on the next CTC-38 I get my hands on!)

The typical symptom will be a complete loss of picture and sound. The AGC will probably have no effect at all.



# "FERRET" TV MINI-ANALYZER

## FOR FAST STEP-BY-STEP TROUBLE SHOOTING

### SUB TUNER

VHF AND UHF TUNER FOR RAPID TESTING OF ALL CHANNELS. CALIBRATED GAIN ADJUSTMENTS PROVIDE FOR SIGNAL STRENGTH COMPARISON.

### DIGITAL GENERATOR

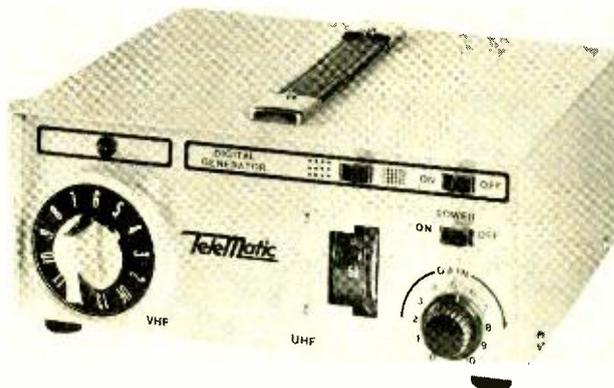
CRYSTAL CONTROLLED \*FOR GENERATING STABLE PATTERNS WHEN CONVERGING RED, GREEN AND BLUE GUNS. IDEAL FOR LINEARITY, PIN CUSHION, CENTERING, FOCUS AND ALL PICTURE ADJUSTMENTS.

### 40 MHz OUTPUTS

IF SIGNALS FROM DIGITAL GENERATOR AND SUB TUNER FOR STAGE-BY-STAGE ANALYZING AND TROUBLE SHOOTING.

The VHF/UHF section of the Ferret allows direct substitution of the TV's tuner for fast, positive localizing of front end trouble.

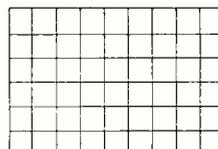
The crystal controlled digital circuitry assures complete accuracy of both the vertical and horizontal frequencies. Accuracy is better than .005%. Output from the generator may be coupled thru the tuner section or directly to the IF-video stages. Resolution is limited only by the picture quality of the TV receiver. Operates from 105 to 125 volts 50-60Hz.



SG 785 \$99.95

### GENERATOR SECTION

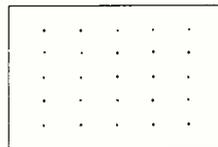
#### CROSS-HATCH



#### LINEARITY ADJUSTMENT

STANDARD FOR VERTICAL AND HORIZONTAL POSITIONING, PICTURE CONTRAST, IF BANDWIDTH TEST

#### DOT PATTERN



#### CONVERGENCE ADJUSTMENT

STATIC AND DYNAMIC CONVERGENCE BEAM ADJUSTMENTS

### SOLD THRU DISTRIBUTORS ONLY

Please send me more information  06

Name \_\_\_\_\_

Address \_\_\_\_\_

Code \_\_\_\_\_



2849 FULTON STREET, BROOKLYN, NY 11207  
PHONE: (212) 827-1500

CIRCLE 60 ON FREE INFORMATION CARD

Remember that the 2nd IF is separated from the first two. You may get a signal through by injecting it into the base of the 3rd IF. If this happens, then the problem is definitely in the 1st and 2nd IF stages. The DC voltage readings will confirm this.

While this looks like a very complex circuit, it really isn't. Take DC voltage readings in both DC paths, the collector-emitter path and the base path. The polarity and the amount of change from normal will give you a good idea as to what has happened.

R-E

## reader questions

### ZENER SUBSTITUTE

*I'm rebuilding a solid-state scope. Thanks to your previous help, it's now functional! One problem left; I need a replacement for a Zener diode, 1N1817R, in the power supply. I can't locate this. Can you help again?—E.L., Niagara Falls, NY.*

I can try! This particular number isn't too popular, but I did find a listing of it in the Sylvania *ECG Replacement Guide*. They show three of them, up to 1N1817C. They have quite a few types; this is a 15-volt Zener. The one listed is

a 10-watt stud-mount type, ECG 5191. If this is too big, they have a 5-watt axial lead type, ECG-5130. Choose the one that seems to match the original.

### RESISTOR FAILURE

*Resistor R314, in the pulse-gate circuit of this Sylvania D-14-3, burns out. However, the set will work for almost a year before it does. This is the third time it's happened. What component is breaking down to cause this?—W.L., Jenison, MI.*

If this set works for that long a time, I doubt if any other part is breaking down. This is shown in the parts list as a 1/2-watt resistor. I believe I'd replace it with at least a 1-watt type, or maybe 2-watt. Should stand up a little better. Resistors in circuits with fairly high pulse-voltages do strange things.

There's no mention of this in any of the Production Change Bulletins.

### HIGH-VOLTAGE PROBLEMS

*I've got all kinds of problems in the high-voltage circuit of this Sylvania D-12! The cathode current of the 6LR6 is too high, the high-voltage is too low, and so on. If I pull the 6BK4 tube, the high-voltage drops to 20 kV, the grid of the 6LR6 goes to -60 volts and the current drops to 170 mA. What goes on here?—A.P., Lexington, KY.*

Something around the 6BK4 high-voltage regulator, I think. There is a "Regulator Limiter" diode in the 6BK4 cathode. Actually, the 6LR6 should have been cut off when you pulled the 6BK4 tube! Check this diode and the circuit.

I see a factory service note on the troubleshooting schematic for this one. It says check R454, which is the grid resistor of the 6BK4. If this opens under load, the high-voltage will go to about 20 kV and other problems show up.

### SHORTED PINCUSHION

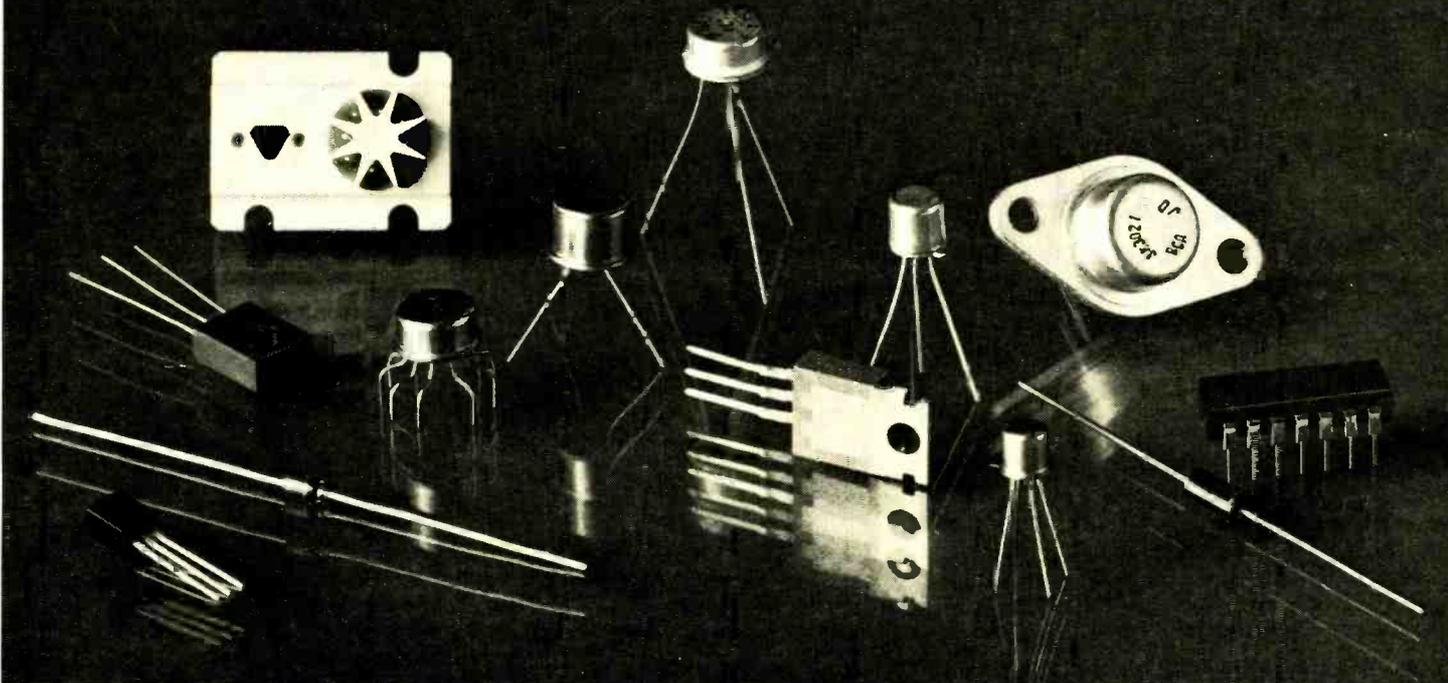
If the pincushion transformer in Sylvania D-19 chassis shorts, check to see if it is a part number 50-33900-3. If so, replace it with a part number 50-39244-1. This is an improved type.

### JUMPS OUT OF CONVERGENCE

*I've had several calls on this Zenith 14CC15. It jumps out of convergence. I can get it back, but it won't stay. Since it affects all three guns, I don't know exactly where to look.—J.T., Orlando, FL.*

This isn't an everyday thing, but I have seen it happen. One good possibility is a "thermal" diode-clamp unit on the convergence board. Try heating and cooling this to see if this will make it show up. This is one of the few things

# Now you can stock only 300 semiconductors instead of 112,000.



that might affect all three guns at once.

### HORIZONTAL INSTABILITY

*I have intermittent horizontal instability and pulling in this Zenith 14M21. I checked and replaced all of the tubes and checked the capacitors. What now?—D.D., Norfolk, VA.*

After the checks you have made, the most likely thing would be an intermittent horizontal AFC diode unit. If one of the diodes is leaking or intermittently opening, this can do it. These diodes must be perfectly balanced. If this doesn't help, check that VDR from the +125-volt source to the grid (pin-7) of the 4HS8 AGC tube. If this is "thermal", it can upset the AGC and several other things at the same time.

### SUBSTITUTE PICTURE TUBE

*Help! We have a Sears 563-51350300 black-and-white TV in our shop. We need a new picture tube; the original is broken. This is a "500SB4". No one has a replacement. Can you tell me anything about this?—G.B., Jamaica, NY.*

A "500SB4" tube would be a 19-inch type. This is "19V" in the new code. The first digits of the original type-number indicate the diagonal measurement in millimeters. So, any of the 19V tubes might work. From the schematic, this seems to have an 8HR base. There are

several tubes using this. Check up and see if a 19AYP4 won't be a pretty good match!

### SSB ADAPTER WON'T WORK

*I've built an SSB adapter from plans in the (BLEEP!) magazine. They say to adjust it for a zero-beat on an AM radio with 455 kHz IF, and then feed it into a CB radio. I can get a loud zero-beat on the AM radio, but nothing at all on the CB. What's wrong?—R.K., Middleburg Heights, OH.*

Normally, I don't comment on plans from other magazines. This *could* be fairly simple, though. One of two possible things. You may have been zero-beating with the station carrier on the AM radio, and not the IF. See if you get the zero-beat on only *one* station. You should hear it on each one.

Two, the CB radio you're using may have a different intermediate frequency. Check this on the schematic.

### BLACK MATRIX TUBE

*Can I use a black matrix picture-tube to replace the 25GP22 in my old TV set?—W.D., Ojai, CA.*

Yes. Just order the same or an equivalent picture-tube with a black matrix screen. There are three types (at least) that will interchange with the 25GP22. These are: 23VANP22, 23VATP22 and C25BAP22. The "23" is the new design-

ation for picture tubes that used to be called "25". I think you'll see quite an improvement!

### BAD PICTURE-TUBE

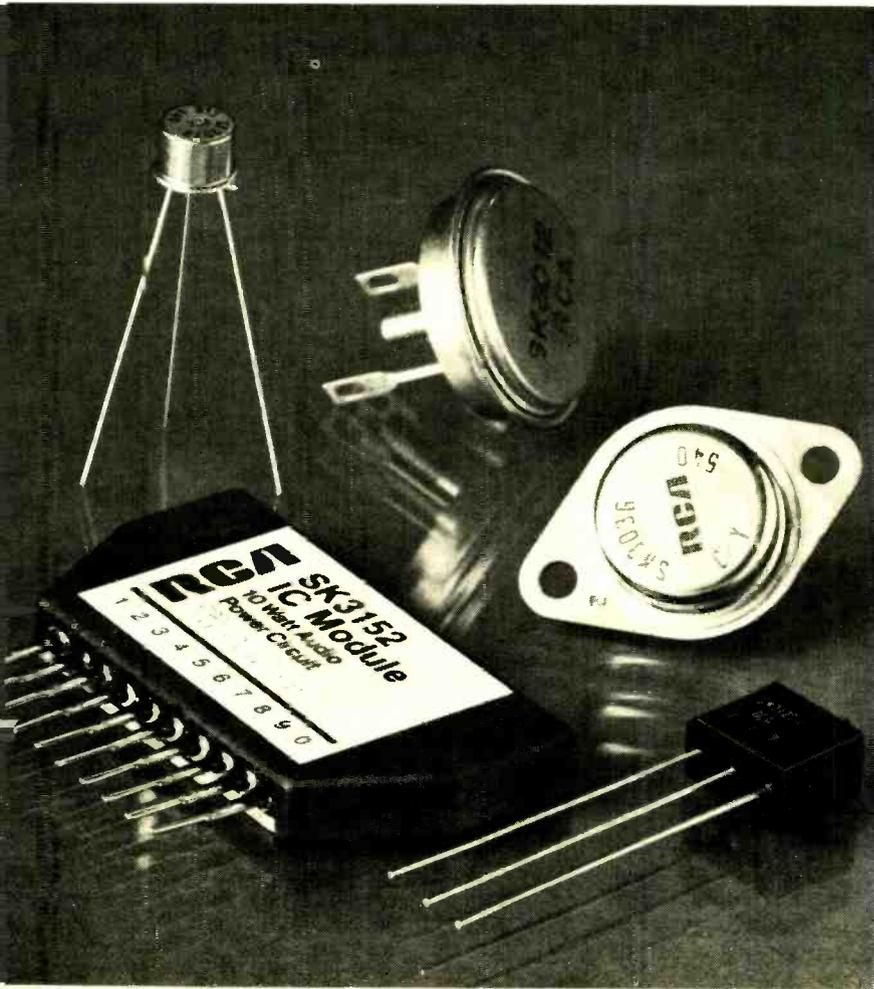
*I've checked everything in the high-voltage section of this set and I can't get any high-voltage. Finally, I pulled the socket off the picture-tube and the high-voltage came back. I checked it on a Tele-Matic test jig, and it makes a good picture. The picture tube is a rebuilt and I've had problems with it. Do you think the picture tube is bad?—M.B., Chicago, IL.*

Yes!

### WEIRD RASTER DISTORTION

*I've never seen a symptom like this before. The raster on this Admiral G13 shows a couple of horizontal bars and with a pull-in with three colors in it at each side. I found a leaky filter capacitor and changed it. No help at all.—Any ideas?—C.K., Churchville, MD.*

One fairly good one. Check the thermal switch on the degaussing coil. This has a habit of sticking, leaking, and so on. If it stuck and left the degaussing coil in-circuit, this could create magnetic fields with just such characteristics. The current through this coil is 120-hz pulses, but it is supposed to be switched completely out of the TV receiver circuits during normal operation. **R-E**



With RCA's SK Series you need stock fewer different semiconductors than you'd have to with any other major brand. Because our 300 devices can replace 112,000. And they're all immediately available.

**OEM Quality.** You don't have to be concerned about quality with RCA SK's. They measure up to strict AQL Standards to protect you from time-wasting callbacks. Lets you make more calls. And more profits.

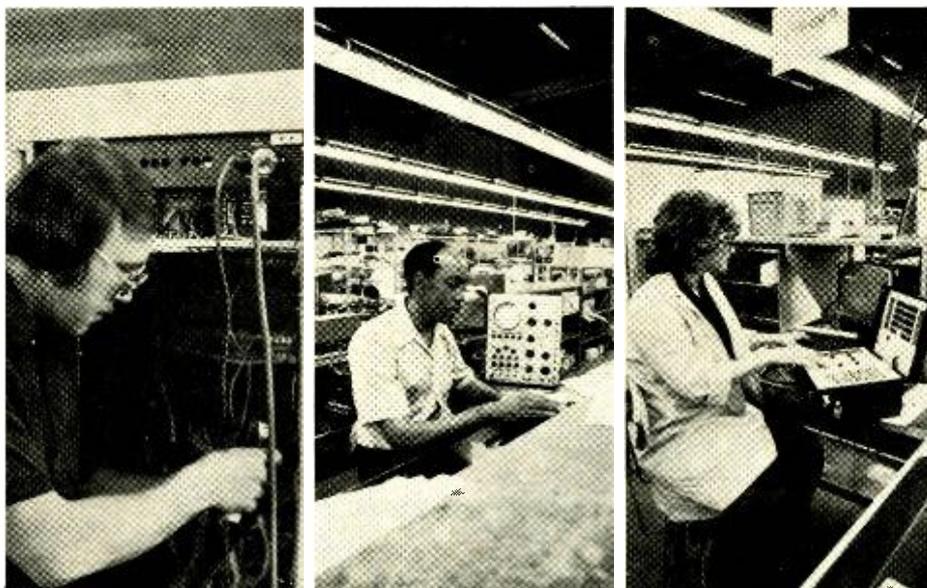
See your RCA Distributor for a copy of the new RCA SK Replacement Guide. Or send \$1.00 to RCA Distributor and Special Products Division, P.O. Box 85, Runnemede, N.J. 08078. Phone: (609) 779-5735.

**RCA** SK Replacement Semiconductors

# You may not know how good you are. But ETI will show you how good you can be.

Perhaps you've heard about all the activity going on in the world of electronics. And maybe you've wondered if it wouldn't pay *you* to get into this exciting field.

Now is your chance to prove just how good you can be in any one of a number of well-paying jobs in electronics. The Electronics Technical Institute can train you at home, in your spare time. And faster than you dare hope.



**Take your choice.** Whether your choice is TV and radio servicing, an FCC-licensed job, computers, solid-state specialties, electronics drafting, or any one of a number of good jobs in electronics, ETI can help you make it through solid, thorough training.

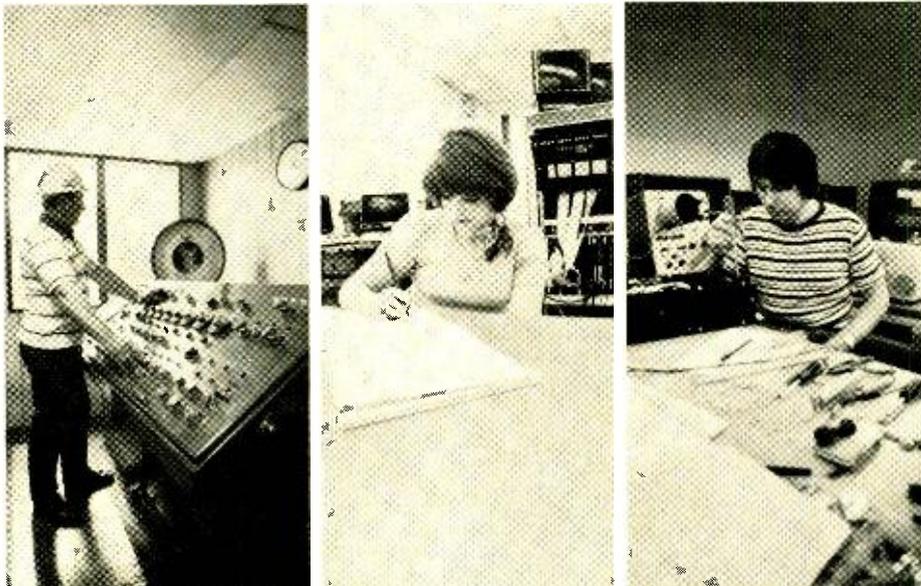
**You can start from the beginning.** Even if you know nothing about electronics, you can start your career with Fundamentals of Electronics, a course which features ETI's special, exclusive, simplified system of teaching called *Autotext*. It's also been called one of the most efficient methods of home study ever developed. You learn fast, learn well and keep what you learn. What's more you'll *enjoy* learning.

**Your ETI instructor—an all-pro.** Working with you will be your personally assigned ETI instructor, a professional in both home study and electronics. Licensed by the State of New Jersey, he knows how to move you ahead quickly. His friendly but straight-from-the-shoulder comments and suggestions at the end of

each assignment will help you take on the next one with enthusiasm and confidence.

**ETI—a leader in home study.** Working for you is the reputation of a school—ETI—that began as the Marconi Institute back in 1909. Employers and professional people respect the work of ETI, because they know its instruction is thorough, complete, and up-to-the-minute in every respect. And thousands of graduates now working in electronics attest to the same thing.

**Hands-on training and experience.** It is not all study when you take an ETI course. In many phases of your training, you use specially developed Project Kits for vital, hands-on experience. You learn by doing, from the very beginning to the completion of



the basic units. As you learn, you build confidence in your ability to get the job done and done well.

**Check it all out.**

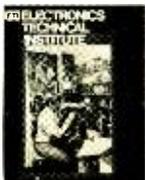
If what we've said seems too good to be true, we'd like you to make us prove it. And you can do that very easily—with absolutely no obligation

on your part—by mailing the coupon or card today. We'll send you all the facts—all the proof you need—in a free, fully illustrated, 48-page Career Book. No salesman will call.

We do believe you owe it to yourself to learn all you can about the many opportunities awaiting you in electronics. The new ETI Career Book will give you the facts you need to decide on a future in electronics, and how you can attain your goal through one of ETI's 18 different courses and programs.

Now it's up to you to take the first step toward an exciting job in electronics.

And that first step is easy. Simply complete the card or coupon and mail today for your free 48-page ETI Career Book.



## Electronics Technical Institute

Division of Technical Home Study Schools

Electronics Technical Institute • Dept. 2-479-106  
Little Falls, New Jersey 07424

Send my free Career Book!

Tell me how I can get ahead in Electronics through ETI. I've checked the fields of special interest to me.

- |   |   |  |
|---|---|--|
| <input type="checkbox"/> TV/Audio Servicing   | <input type="checkbox"/> Computers  | <input type="checkbox"/> Business and Engineering  |
| <input type="checkbox"/> Black & White Color Solid State CATV Closed Circuit Video Recorders Radio Hi-Fi Stereo | <input type="checkbox"/> Digital Electronics Computer Technology Computer Programming | <input type="checkbox"/> Electronics Fundamentals Electronics Drafting Industrial Electronics Advanced Electronics Industrial Instrumentation Electronics Technology Medical Electronics |
| <input type="checkbox"/> Communications   | <input type="checkbox"/> FCC License Aircraft Marine Mobile Two-Way Microwave         |  |

Check here for Veteran information.

Name \_\_\_\_\_ (please print)

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

CIRCLE 35 ON FREE INFORMATION CARD

OCTOBER 1976

# SAVE UP TO 50% ON PARTS.

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

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

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

Now, assembling, testing and modifying circuits is as easy as pushing in — or pulling out — a lead. IC's, LED's, transistors, resistors, capacitors... virtually every kind of component... connect and inter-connect instantly via long-life, nickel-silver contacts. No special patch

MODEL	NO. OF TIE-POINTS	14-PIN DIP CAPACITY	SUGG LIST *	OTHER FEATURES
PB-6	630	6	\$15.95	Kit — 10-minute assembly
PB-100	760	10	19.95	Kit — with larger capacity
PB-101	940	10	29.95	8 distribution buses, higher capacity
PB-102	1240	12	39.95	Large capacity, moderate price
PB-103	2250	24	59.95	Even larger capacity, only 27¢ per tie-point
PB-104	3060	32	79.95	Largest capacity, lowest price per tie-point
PB-203	2250	24	75.00	Built-in 1% regulated 5V, 1A low-ripple power supply
PB-203A	2250	24	120.00	As above plus separate 2-amp +15V and -15V internally adjustable regulated outputs

\* Manufacturer's suggested list  
Prices and specifications subject to change without notice

cards or jumpers needed — just lengths of ordinary #22-30 AWG solid hookup wire.

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

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

CONTINENTAL SPECIALTIES CORPORATION



44 Kendall Street  
Box 1942 New Haven, CT 06509  
203-624-3103 TWX 710-465-1227  
West Coast office: Box 7809, San Francisco, CA  
94119 • 415-421-8872 TWX 910-372-7992  
Canada: Len Finkler Ltd., Ontario

© 1976 Continental Specialties Corporation



CIRCLE 63 ON FREE INFORMATION CARD

# Step-by-step TV Troubleshooters Guide

*You might call it an amplified-burst reference oscillator, but its not an oscillator. Actually, the 3.58 MHz burst is gated out, amplified and used as the chroma reference. Here's how to troubleshoot it*

**JACK DARR**  
SERVICE EDITOR

SEVERAL COLOR OSCILLATOR CIRCUITS ARE used in color TV sets. We discussed the crystal-controlled type with a phase detector and reactance stage in 1974. Another type is used in several makes, but is probably most familiar in such chassis as G-E's CB, KC, KD and KE. It might be called an "amplified-burst" reference oscillator, since that's actually just what it does. The actual burst from the color signal is gated out, amplified, and becomes the 3.58-MHz reference oscillator signal. Let's go through this type of circuit and see how it works:

Figure 1 shows a typical circuit. This one is from G-E's CB chassis. For the first step, the burst is gated out of the complete color signal and amplified. Note that the cathode of the burst-gate tube goes back to ground through the secondary of the bandpass transformer. This is the source of the color signal and burst for the gate stage. The burst-gate stage actually has some amplification; so, the burst comes out at a greater amplitude.

This is fed into a transformer as a series of bursts of 3.58-MHz signal. The transformer primary is tuned to this frequency. In its secondary, the crystal is connected in series as a "filter". (A crystal can be considered as a very sharply-tuned filter, with a tremendously high Q and very narrow bandpass. That's what they're doing with it here.) Since both transformer and crystal are tuned to 3.58 MHz, the burst shocks them into ringing. Ringing causes the circuit to sustain oscillations for a much longer time. Another tuned circuit is used in the grid of the subcarrier amplifier for the same purpose. The combined action of all these resonant circuits keeps the 3.58-MHz signal going until the next burst arrives and boosts it up again.

Don't call the subcarrier amplifier the "3.58-MHz oscillator", it isn't. It is an amplifier designed to raise the amplitude of the reference 3.58-MHz signal to the necessary level and also to limit it, if needed. Limit but never clip. If it clips it flattens the tops of the waves and introduces all kinds of harmonics that we don't need. Figure 2-a shows the burst on the back porch of the horizontal sync, the sharp gating pulse is shown in Fig. 2-b, the gated-out burst in Fig. 2-c, the ringing output of the crystal transformer in Fig. 2-d and the subcarrier amplifier output in Fig. 2-e. In the waveform of Fig. 2-d, you can see the slow decaying of the amplitude of the burst. By the time this gets through the other tuned circuit and the amplifier, it is smoothed off and looks like Fig. 2-e.

In Fig. 1, there is a 5-60 pF, variable capacitor connected in the plate circuit of the subcarrier amplifier. Figure 3 shows a later version used in KC and KD chassis. The tint

is controlled by a varactor diode connected in the grid circuit. The actual TINT control is a variable resistor that is part of a voltage divider network fed from the +270-volt line. Figure 4 shows the same stage as used in the KE chassis. A transistor buffer amplifier has been added between the crystal-tuning coil and the grid of the subcarrier amplifier. This provides better isolation during the scan period to prevent any undesired 3.58-MHz signal from feeding through the capacitance of the burst-gate tube.

Let's look at another novel circuit used in some of the early runs of the KC and KD chassis. This is shown in Fig. 5. Note the little neon lamp in the grid circuit of the burst-gate tube. A positive-going pulse from the

flyback, about 150 volts P-P, is applied to it. The 1500- $\mu$ H choke and .0018- $\mu$ F capacitor form a resonant circuit that is tuned to about 90 kHz. It's damped by the 270-ohm resistor. Once again, the "decaying pulse" reaction is used. This time, only the first half-cycle of the pulse is high enough to make the neon lamp ionize and conduct. This pulse is shaped into a squarewave by the other parts in the grid circuit.

This stage neatly "punches-out" only the color burst and passes it along after amplifying it to the input of the crystal-filter transformer (Fig. 3). The series-resonant circuit in the burst-gate grid, 100- $\mu$ H choke and 18-pF capacitor, resonates at 3.58 MHz. This acts as a trap to prevent any other 3.58-

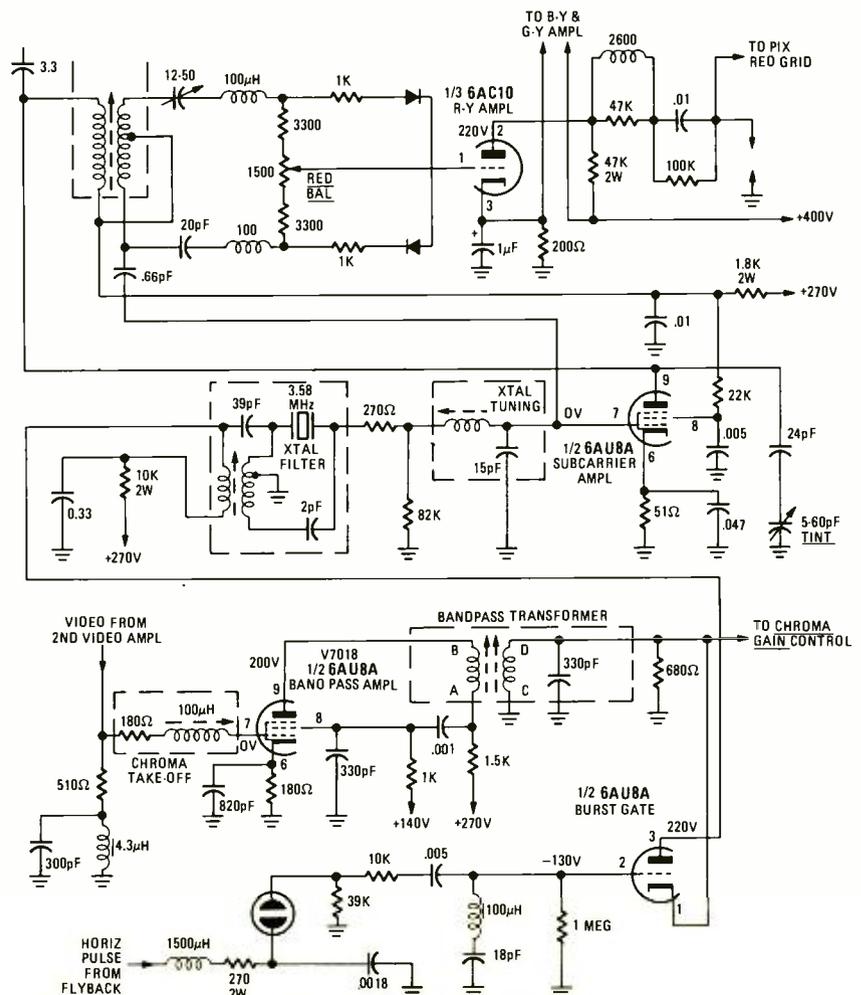


FIG. 1—G-E CB COLOR BURST OSCILLATOR and part of demodulator.

MHz signals from getting into the circuit while the gate tube is cut off during the scan period.

### The crystal transformer

The 3.58-MHz crystal and the transformer build up the amplitude of the burst signal. The transformer primary is tuned to 3.58 MHz. The burst is coupled to the secondary and because of the reaction of a resonant circuit, it is amplified. It is then fed through the crystal causing it to ring, which sustains oscillation for a longer period. These are all very high-Q circuits that maintains the amplitude of the signal. The crystal-tuning coil is also resonant at 3.58 MHz, which keeps the amplitude up still longer. So, in the end, we come out with a sustained oscillator signal phase-locked with the burst (which is natural considering that it is the burst!) and at the amplitude needed to drive the demodulators.

### Troubles

That's how it works when it works. Now let's look at this circuit and some of its reactions when it isn't working right.

For one, the horizontal oscillator frequency is critical. If there is a problem in the horizontal AFC, which lets the oscillator run just a little off frequency without losing horizontal hold, you can see problems in the color. This is due to the precisely-timed gating needed to punch out the color burst. Just a little too much phase difference can weaken the burst and cause a color problem. Be sure that the horizontal hold is set "right in the middle".

In the chassis using the neon lamp in the burst-gate circuit, the lamp is very important. I used to say "the burst goes through the neon lamp" but, of course, it doesn't. The gating pulse does, which has the same effect. If this lamp goes bad, you can have intermittent color, no color, weak color, wrong color,

or "the color won't come on until it's been on for several minutes". If you lose the burst, of course, you've got problems. Check this little lamp; you can usually see it light. With the set off, see if the bulb is blackened or broken. The glass should be clear. If it's bad, replace it. The G-E part number is ET41X6, which is a NE83/5AH or NE-2H. You can often replace this from the top of the chassis. Clip the leads of the old one and tack the new one to them. Don't leave the leads too long.

If the lamp looks OK but you still have problems (lamp not glowing), check to make sure that the gate pulse from the flyback is present. This too can be checked with the scope from the top of the chassis. A bad ground on the pulse winding of the flyback can cause all the symptoms given above, from the same cause.

Tubes should be checked by replacement, and for goodness sake use the same type. You can really build in a whole brand new set of mysterious symptoms if you use a substitute with different characteristics. Check DC voltages, too.

If the complaint is "wrong colors", check parts that could upset the phase relationship. Check the tint control circuitry and the alignment of the crystal transformer and filter coils. As a last resort, try a new crystal.

**WARNING:** The crystals used in this circuit are not the same as those used in the other type of crystal oscillator circuit. If the set has been worked on before, check the crystal to be sure that someone hasn't used the wrong replacement. This crystal acts as a filter with a tremendously high Q, so it is critical.

In the sets with a varactor tint-control, if you have no tint-control action or incorrect colors, or both, check the DC voltage on the varactor, the resistors in the voltage divider, or try a new varactor diode. The DC voltage on the cathode of this diode will run about +7.5 volts properly centered. G-E gives this on one schematic as varying between +68 volts with the tint control full counterclockwise, and +3.1 volts full clockwise. Be sure that this DC voltage does vary as the tint control is turned. One problem that has been found is a bad ground on the tint control itself. If it is open, the tint control voltage will go completely out of range.

### Alignment

The results of color alignment in this circuit are the same as in the others, but the methods are different. You can't use the "ground the grid of the burst amplifier and adjust the oscillator" technique. This circuit will not free-wheel, since the amplified burst is the oscillator signal. To align, feed in a known color signal from a color-bar generator or an off-the-air program. Connect a VTVM or FETVM to the test point. This will be one of the demodulator diodes. Any of the diodes can be used, but G-E recommends the lower diode of the red demodulator. If the 3.58-MHz signal is present, you'll see a small DC voltage here. Since this is on the cathode, it will be positive. You can use the other diode but the voltage will be negative since you'll be on the anode. Tune for maximum DC voltage, positive or negative.

Align the crystal transformer primary and the crystal tuning coil for a peak. Ballpark values of this voltage will be about 10 volts or more. (For the next step in a complete alignment you'll tune up the demodulator transformers using the same test point. This is

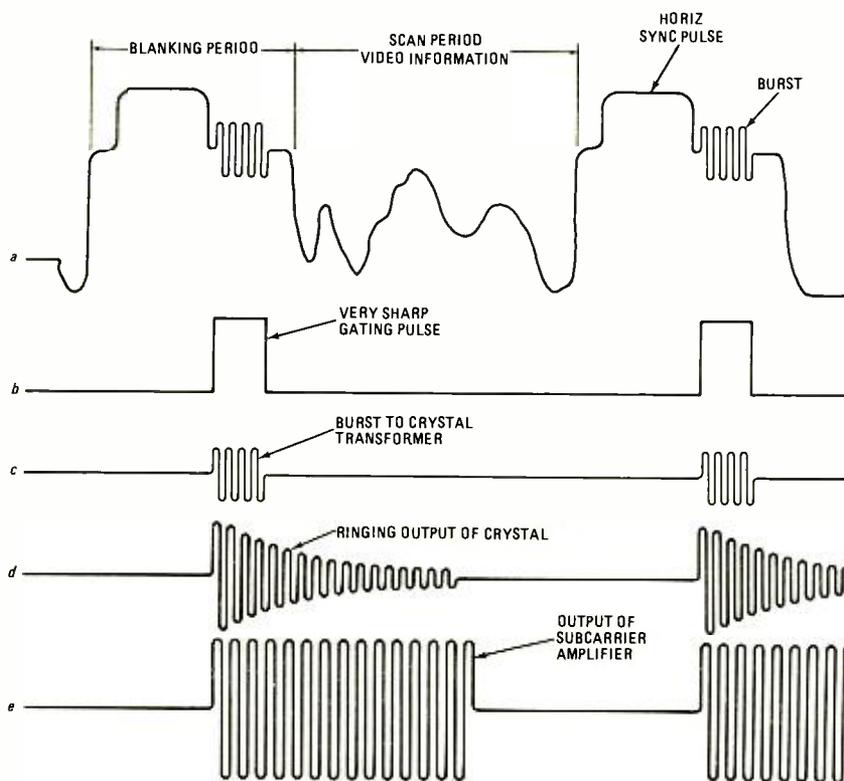


FIG. 2—WAVEFORMS in each step of the circuit. The scan period with burst is shown in a. The sharp gating pulse is shown in b. Burst to Y701 and Y702 is shown in c. Subcarrier amplifier output is shown in e.

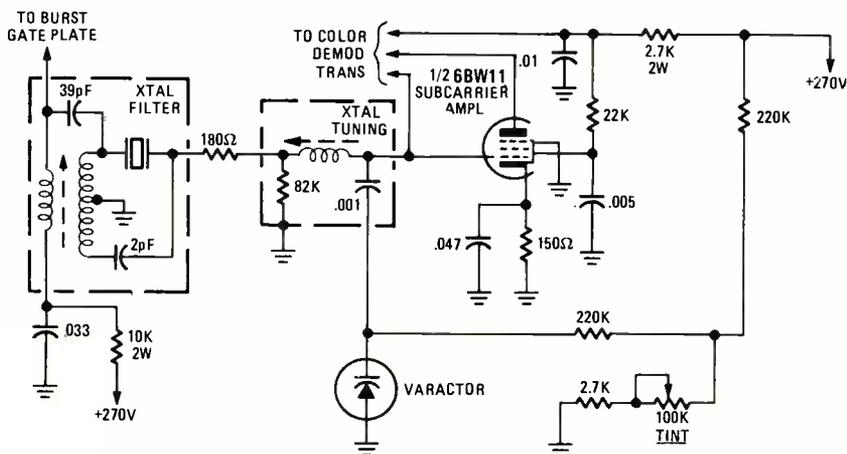


FIG. 3—BURST-GATE AMPLIFIER and crystal filter in the G-E KD color chassis.

for demodulator alignment rather than reference oscillator setup.) Follow the set-maker's alignment procedures carefully. In practically all of these, you'll find the test points printed on the PC board, which makes things very nice!

### Step-by-step testing

This circuit is ideal for step-by-step test

methods since it's basically a series circuit. You can walk troubles out with very little difficulty. The first step, as usual, is to make sure that everything else is all right! This means that the set must be able to make a good clean picture, with no sync, AGC, or other problems. The horizontal hold control must be centered and the horizontal sync stable. (Fix all of these and you may not have

color problems any more!)

Trouble in the reference oscillator will cause weak color, wrong color or no-color problems. It will not cause "one-color" problems such as "green screen" etc; these will be in the demodulators, diff-amps or picture tube. You must have a good clean normal amplitude video signal at the video detector output.

Now, we can go. The first step in this is to verify the identification of the problem. With a color-bar signal input, you can scope the output of the bandpass amplifier and make sure that the characteristic comb pattern is

### TROUBLESHOOTING CHART. Amplified-burst oscillators.

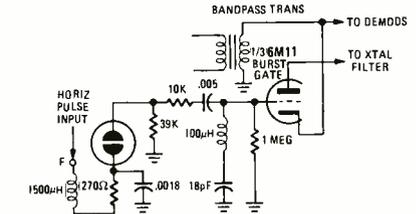
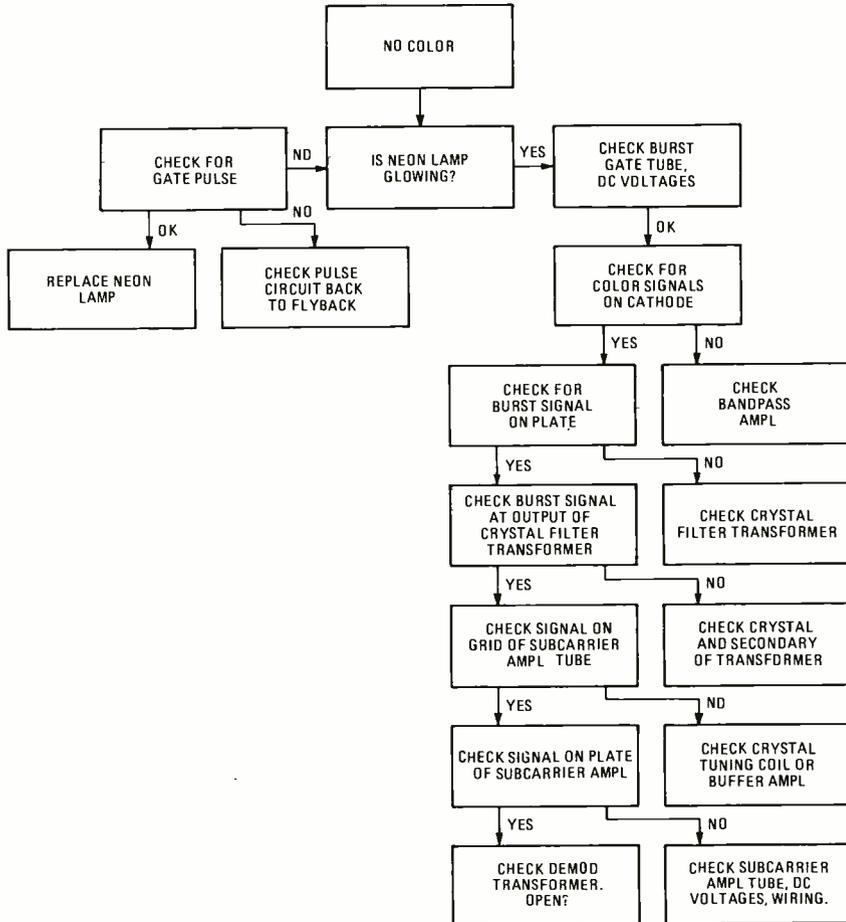


FIG. 5—EARLY KC AND KD CHASSIS used a neon tube before the crystal filter.

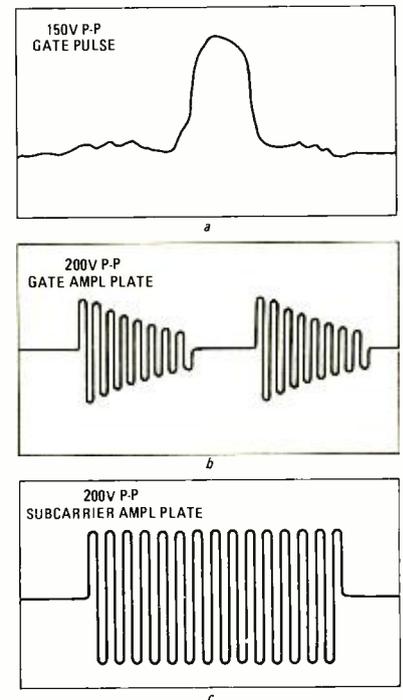


FIG. 6—SOME TYPICAL WAVEFORMS and voltages, on CB, KC and KD chassis.

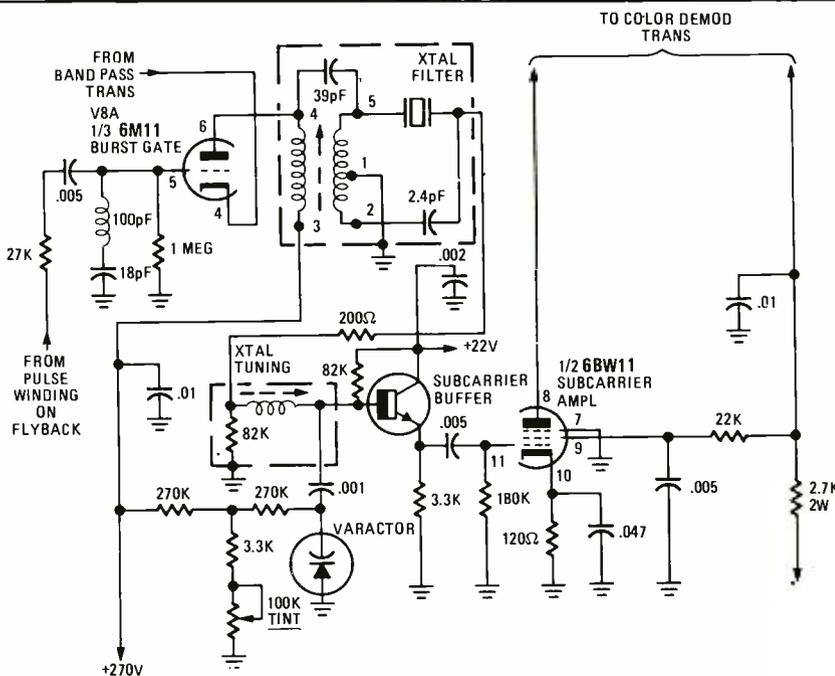


FIG. 4—KE VERSION uses a buffer stage.

present at the correct amplitude. The next step would be to scope the demodulator input to make sure that the reference oscillator signal is or isn't present there. If it isn't, we know that the trouble is definitely in the reference oscillator circuitry.

Start back at the burst-gate stage. Scope the input to be sure that the gating pulse is there. Next, check for the gated-out burst signal on the plate of the burst-gate stage. Fig. 6 shows the waveforms you should find in one G-E chassis. Figure 6-a is the gating pulse, Fig. 6-b is the gated burst, and Fig. 6-c output of the subcarrier amplifier. Peak-to-peak amplitudes are as shown. If the gate pulse is OK but there is no burst output, check for the presence of the color signal (the comb) on the cathode of the burst-gate tube.

continued on page 114

The Best  
Way To Show  
You What  
You'll Get  
Out Of An  
Empire  
Phono  
Cartridge  
Is To  
Show You  
What Goes  
Into One.

At Empire we make a complete line of phono cartridges. Each one has slightly different performance characteristics which allow you to choose the cartridge most compatible to your turntable.

There are, however, certain advantages, provided by Empire's unique design, that apply to all our cartridges.

One is less wear on your records. Unlike other magnetic cartridges, Empire's moving iron design allows the diamond stylus to float free of its magnets and coils, imposing much less weight on your record's surface and insuring longer record life.

Another advantage is the better channel separation you get with Empire cartridges. We use a small, hollow iron armature which allows for a tighter fit in its positioning among the poles. So, even the most minute movement is accurately reproduced to give you the space and depth of the original recording.

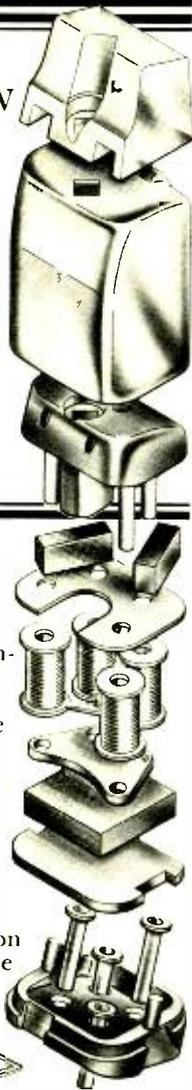
Finally, Empire uses 4 coils, 4 poles, and 3 magnets (more than any other cartridge) for better balance and hum rejection.

The end result is great listening. Audition one for yourself or write for our free brochure, "How To Get The Most Out Of Your Records". After you compare our performance specifications we think you'll agree that, for the money, you can't do better than Empire.

Empire Scientific Corp.  
Garden City, New York 11530

**EMPIRE**

Already your system  
sounds better.



# new products

More information on new products is available from the manufacturers of items identified by a Reader Service number. Use the Free Information Card following page 116.

**OPEN-REEL STEREO DECK, model SG-630**, has three-speed operation and exclusive Omega drive system for stabilized tape speed. New electronic tape tension regulation with "motionless sensors" keeps tension constant regardless of the mode of operation and is completely uninfluenced by spool diameter at any time, even when going from one mode of operation to another. Switching directly from fast wind to rewind is easily accomplished, even simultaneously, without tape spill.

The Omega drive system eliminates the pinch roller, drive couplings, springs and function wheels—parts that traditionally wear out. The logic-controlled tape transport machine features a four-motor drive system with two newly developed DC hub motors and a collectorless electronically regulated motor for the capstan drive and a servo motor to form the Omega loop.



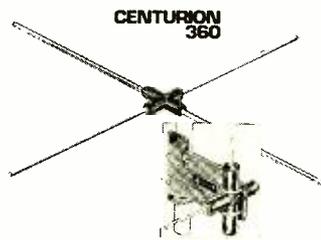
All the operating controls are arranged on the front panel and the tape transport mechanism is controlled by means of illuminated function indicators. Actual tape speed may be verified with a built-in stroboscope disc that works in conjunction with a speed control. A fast peak-reading meter with relatively long return permits simultaneous and precise control of both stereo channels.

The SG-630 has a built-in "Dia-Pilot" for recording signal impulses and automatic slide projector control for either single projector or multi-media show. Also featured is a switchable peak-level meter, separate stereo headphone power storage with its own volume control, separate bass and treble tone controls, A/B monitoring, and remote control facilities. Specifications include: signal-to-noise ratio, better than 67 dB; wow-and-flutter, 0.02%. Suggested retail price is \$1,100.00—Uher of America, 621 S. Hindry Avenue, Inglewood, CA 90301.

**CIRCLE 86 ON FREE INFORMATION CARD**

**CB BASE-STATION ANTENNA, Centurion 360**, is a cross-polarized antenna that has 18-foot 3-inch elements, a sealed extra length Cyclocab center-insulator and generates up to 15.4 dB gain. Antenna has omni-directional response and a power handling capability of 1000-watts

AM or 2000-watts SSB. Elements are constructed of anodized aircraft aluminum and the wind rating is 90 miles per hour.



The antenna will mount vertically from a window sill or frame, or vertically and horizontally from a master tripod. Weighs 5-pounds 10-ounces and sells for less than \$90.00.—Aire-quipt, Inc. 1301 Brummel Ave., Elk Grove, IL 60007.

**CIRCLE 87 ON FREE INFORMATION CARD**

**DIGITAL MULTIMETER, model 283**, has high intensity 3 1/2-digit LED display, 0.41-inch high that can be easily read in brightly lit rooms at a distance of at least six feet. It measures DC volts, AC volts, DC current, AC current and resistance. A special low voltage circuit permits measuring resistance of transistor-shunted resistors.

Model 283 has 100% overrange capability on four ranges, so that one can read to 199.9 on a scale that is normally set for 100.0 maximum. Out-of-range is indicated by a flashing digit and three zeros. All readings have an automatically positioned decimal point.



There are 4 DC voltage ranges, with  $\pm 0.5\%$  accuracy on the 1.000, 10.00 and 100.0 ranges and  $\pm 1.0\%$  on the 1000-volt range. Polarity change is automatic. Four AC voltage ranges have  $\pm 1.0\%$  accuracy on 1.000 and 10.00-volt ranges and 1.5% accuracy on the 1000-volt range. There are four AC current and four DC current ranges with the similar accuracies. The six resistance ranges (100 ohms, 1K, 10K, 100K, 1000K and 10 megohms) have  $\pm 1\%$  accuracy, except top range which is  $\pm 2\%$ . Input impedance is 10 megohms on all voltage ranges. Overload protection is provided, up to 1000 volts

on the ohms, 1500 volts on the voltage ranges, and 3 amperes on current shunts.

An optional battery pack provides 8 hours of operation on an overnight charging. Batteries also charge when the *model 283* is used on 110 VAC powerline.

The multimeter weighs only 3 pounds and measures 9 × 7 × 3.6 inches. With battery pack weight is 6 pounds.—**B&K Precision, Dynascan Corporation**, 6460 W. Cortland, Chicago, IL 60635.

**CIRCLE 88 ON FREE INFORMATION CARD**

**DIGITAL CB-TESTER, model 388**, is a combination SWR, power, % modulation and frequency meter.



The SWR and % modulation functions allow continuous monitoring as output power is adjusted or fluctuates without troublesome recalibration steps, thus saving valuable service time. The *model 388* may be switched between any of the functions without recalibration while maintaining rated accuracy. A front-panel mounted BNC-connector enables frequency measurement from 1 Hz to 80 MHz with full 7-digit counter capability and resolution to 10 Hz. An AM output jack on the front panel permits

scope display of modulation

The *model 388* with standard timebase has a frequency accuracy of 10 parts-per-million. The available *model 388X* with a Temperature Compensated Crystal Oscillator (TXCO) timebase has a frequency accuracy of 1 part-per-million and aging of less than 1 part-per-million per year. The *model 388X* requires less frequency recalibration reducing service-bench downtime.

Both units are rack mountable using the new Hickok rack mount kits designed to mount the complete Hickok line of test instruments in standard 19-inch racks. Minor internal modification allows 12 VDC operation of the *model 388* or *388X*.

Prices are: \$349.00 for the *model 388* and \$475.00 for the *model 388X*.—**Hickok Electrical Instrument Co.**, Marketing Services, 10514 Dupont Avenue, Cleveland, OH 44108.

**CIRCLE 89 ON FREE INFORMATION CARD**

**TURNTABLE, model 1000**, is a belt driven unit that incorporates two motors. A smooth running 24-pole 300-RPM synchronous motor is used to drive the turntable only. A second motor controls the cue and change cycle. Operation is unique; the turntable stops when cued or in cycle. This facilitates reading the record label and provides more precise cueing control. A printed-circuit board controls the cue and cycle operation. Electronic touch-buttons initiate all actions and LED's illuminate to indicate the operations that are taking place.

The turntable has machined strobe markings on the perimeter. The strobe light has a built-in speed control and acts as a pilot light to show that the electronic circuit is operational. Other features include: electronic speed control using frequency to control speed through a Wien bridge oscillator, a new low-mass cartridge skeletal head-shell, removable plug-in record support post, a tonearm system with a new CD-4 position in its anti-skating control and comput-

er-designed isomer shock mounts. Price:



\$279.95.—**British Industries Co.**, Westbury, NY, 11590.

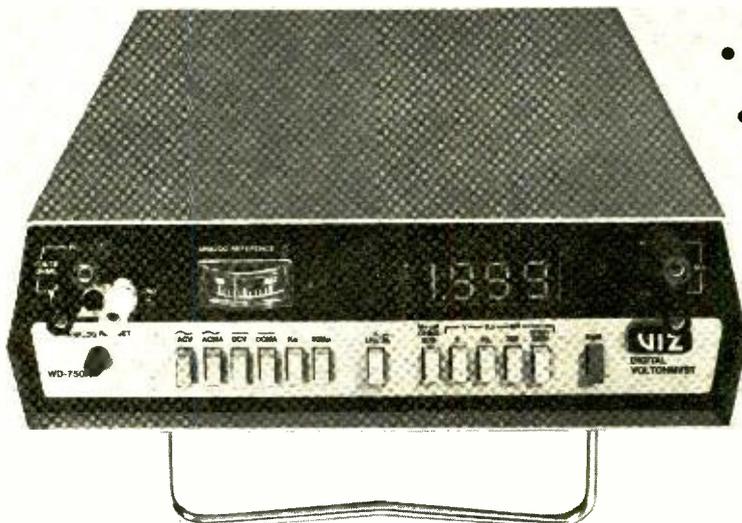
**CIRCLE 90 ON FREE INFORMATION CARD**

**CASSETTE DECK, model 350**, is a compact deck that can be used just about anywhere. The unit is powered by 12 volts DC, but an AC power pack (included with the unit) permits its use indoors with household AC power. Other features include: three low-noise low-impedance microphone inputs with individual input level controls, 8-ohm stereo headphone output, Dolby noise reduction, tape selection, and a single 35-dB range peak-reading level meter that indicates the higher of the two channels at any given instant. An automatic shut-off function not only shuts off power to the deck, but also completely disengages the transport at the end of the tape or if the power to the unit is interrupted. Specifications include: frequency response, 40 to 15,000-Hz ± 3 dB; signal-to-noise ratio, better than 58 dB; total harmonic distortion, less than 2%; channel separation, better than 35 dB; crosstalk, better than 60 dB; wow-and-flutter, less than 0.08% (WRMS).

Heavy-duty carrying case is available as an

# Built to last

Our new 3½-digit LED autopolarity digital VoltOhmyst® is quality-constructed for long, hard service.



**WD-750A**  
**\$267.00**

- Fast and accurate measurement of ac and dc volts, current, and resistance.
- Built-in analog panel meter for peaking and nulling.
- Hi- or Lo-power ohms selector.
- 120V/240V ac or battery operation with built-in charger.
- RF shielded, with rugged vinyl-clad case.

**VIZ Test Instruments Group**

of **VIZ Mfg. Co.**

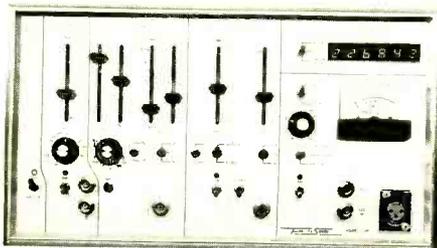
335 E. Price St.  
Phila. PA 19144

© VIZ

6645

Formerly  
**WIZ**  
Instruments

**CIRCLE 69 ON FREE INFORMATION CARD**



**MODEL 100 AUDIO RESPONSE PLOTTING SYSTEM** and general purpose sweep/tone burst/pulse generator consists of two sine /square/triangle function generators, pulse generator, frequency counter and peak amplitude measurement sections. It is primarily intended to generate a frequency response plot on an X-Y recorder or scope.

Time base generator offers symmetrical or independent control of the positive and negative sides of the ramp providing a duty cycle of .7% to 99.3%. Frequency range is .0035Hz to 100kHz. Amplitude is 15Vpp into 500 ohms with  $\pm 5$ VDC offset. The time base output drives the X axis of an X-Y recorder.

Audio sweep generator provides manual frequency adjustment or log/linear sweep of 20Hz to 20kHz. Blanking mode produces zero reference line on X-Y recorder or tone burst. Amplitude is 15 Vpp into 500 ohms or 10 Vpp into an 8 ohm speaker.

Pulse generator frequency range is .0035Hz to 525kHz. Pulse width is adjusted independent of frequency from 4 seconds to 40 nanoseconds. Outputs are complimentary TTL.

Peak amplitude measurement section measures internal or external signals from mike to power amp level. Amplitude output drives Y axis of X-Y recorder.

Frequency counter is 6 digit, line triggered, and reads either internal or external. Sensitivity is 50 mv peak at 20kHz.

Dimensions: 8 x 14 x 3. Warranty: 1 year. \$525, stock to 30 days.

FIDELITY SOUND

1894 Commercenter W. #105  
San Bernardino, Ca 92408  
(714) 889-7623

**CIRCLE 9 ON FREE INFORMATION CARD**

optional accessory. A rechargeable lead-acid 12-volt battery is built into the carrying case so that the 350 in its case will be a self-powered unit. The carrying case also contains a circuit that converts the 350's AC power pack into a recharging unit. A 12-hour charge permits five to six hours of continuous recording.

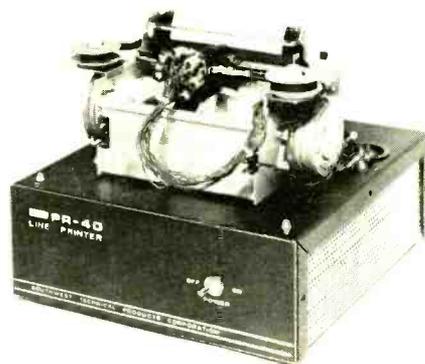


Measuring  $7\frac{1}{3} \times 3\frac{1}{2} \times 9\frac{1}{2}$  inches (without carrying case) and weighing 7 pounds, the unit sells for \$350.00. The optional carrying case sells for \$100.00—**Nakamichi Research (U.S.A.), Inc.**, 220 Westbury Avenue, Carle Place, NY 11514.

**CIRCLE 91 ON FREE INFORMATION CARD**

**ALPHANUMERIC PRINTER KIT, model PR-40**, is a  $5 \times 7$  dot matrix impact printer. It prints the 64-character upper-case ASCII set with 40 characters-per-line at a print rate of 75 lines-per-minute on standard  $3\frac{7}{8}$ -inch wide rolls of adding machine paper. One complete line is printed at a time from an internal 40-character line buffer memory. Printing takes place either on the receipt of a carriage return or automatically whenever the line buffer memory is filled.

The printer is available in kit form only and includes the assembled print mechanism, chassis, circuit boards, components, 120/240-VAC, 50/60-Hz power supply, assembly instructions, one ribbon and one roll of paper. It sells for \$250.00 postpaid in the US and delivery is 30



days.—**Southwest Technical Products Corp.**, 219 W. Rhapsody, San Antonio, TX 78216.

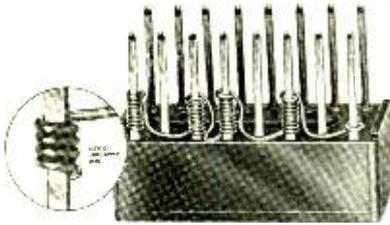
**CIRCLE 92 ON FREE INFORMATION CARD**

**WIRE-WRAP TOOL, Slit-N-Wrap**, intended for manual and hand-held electric motor tools. Makes possible a reduction in wiring time of about 80% over conventional manual wrapping. Wire is drawn off the spool at the top of the tool, led through a tube past a slitting-edge adjacent to the wrap-post. A narrow slit is made in the thin, but tough, insulation in the region that overlays the square corners of the post so the bare copper makes a good wire-wrap joint. The wire slits cleanly where required, but is not cut when pulled out in going from post to post. Unlike other strip and wrap tools which will strip and wrap only one end of a wire, this tool will

# 25 Invitations to great reception.



quickly connect both ends. Available in two models: The hand-rotated *P180* is \$24.50 and comes with instructions, the forming tool and



two 100-foot spools of 28-gauge wire. The *P160-4T*, a cordless, battery-operated version that sells for \$69.00, is also available.—**Vector Electronic Company**, 12460 Gladstone Ave., Sylmar, CA 91342.

**CIRCLE 93 ON FREE INFORMATION CARD**

**FM BOOSTER** operates through the existing FM car radio and antenna and gives better than 15-



dB gain on weak stations. Slightly larger than a pack of cigarettes, the compact FM booster is

installed under any car or trunk dashboard, and amplifies weak signals and mutes background noise of hard-to-get stations. The unit is vinyl finished in a black steel case with chrome trim.—**Solitron Devices, Inc.**, 256 Oak Tree Road, Tappan, NY 10983.

**CIRCLE 94 ON FREE INFORMATION CARD**

**CB TRUNK-LID MOUNT**, *model TLM*, clamps to the vehicle with stainless steel hollow-head screws that provide a positive ground and will



not rust or freeze in place. A special no-mar molded gasket is provided to protect the car finish. Finished in high-polish chrome, the mount comes complete with 17 feet of RG-58A/U coax and plug. The *model TLM* is available with hardware to accommodate all standard antenna mounts including Motorola, Larsen,



**Our whole family helped assemble this wonderful Schober Organ... and now we all play it!**

Talk about real family fun! We all worked together, for a few hours almost every day. Almost too soon, our Schober Organ was finished. Our keen-eyed daughter sorted resistors. Mom soldered transistor sockets, although she'd never soldered anything before. And it did our hearts good to see the care with which our son—he's only 12—installed the transistors. Me? I was the quality control inspector—they let me do the final wiring.

Our completed Schober Organ compares favorably with a "ready-made" one costing twice as much! (The five models range from \$650 to \$2850.)

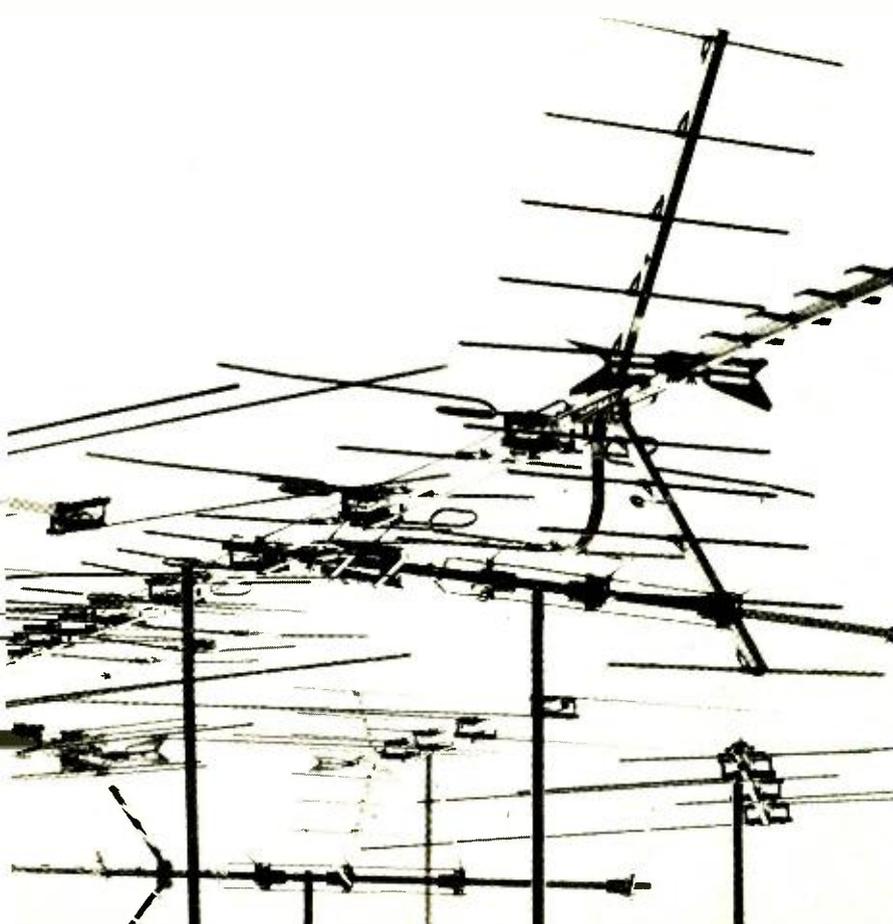
Just send the coupon for the fascinating Schober color catalog (or enclose \$1 for a 12-inch LP record that lets you hear as well as see Schober quality).

**The Schober Organ Corp., Dept. RE-155**  
**43 West 61st Street, New York, N.Y. 10023**

Please send me Schober Organ Catalog.  
 Enclosed please find \$1.00 for 12-inch L.P. record of Schober Organ music.

NAME \_\_\_\_\_  
 ADDRESS \_\_\_\_\_  
 CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_

**CIRCLE 24 ON FREE INFORMATION CARD**



**Outdoor antennas, for sure.** For UHF, VHF and FM — and almost any combination. Plus Mini-State — RCA's newest and most advanced miniature rotating antenna for the best possible reception in apartments, homes, boats, trailers and RVs.

**We don't stop there, either.** Our line of great rotators for outdoor antennas, our reception aid amplifiers, splitters, transformers, and our easy-as-pie mounting hardware, give you the most complete line of invitations for great reception anywhere.

**RSVP.** For all the details, see your RCA Distributor — or contact RCA Distributor and Special Products Division, Cherry Hill, N.J. 08101. Phone: 609-779-5763.

**RCA** Permacolor  
Outdoor Antennas

ASP, G-E, RCA, etc. It is also available complete with antenna and even without either antenna or mounting hardware.—Larsen Electronics, Inc., P.O. Box 1686, Vancouver, WA 98663.

**CIRCLE 95 ON FREE INFORMATION CARD**

**AM CB MOBILE, model Sabre**, has sloped front-panel and dimmer switch for controlling light intensity. SWR/RF/S meter and LED channel readout for night time use. Other controls include a volume, tone, SWR, Delta tune and



squelch selector plus PA/CB switches. It incor-

porates a fully variable noise-limiter and a switchable noise-blanker. It measures 9.34 x 6.92 x 2.34 inches.—Browning Laboratories Inc., Laconia, NH 03246.

**CIRCLE 96 ON FREE INFORMATION CARD**

**RECORD CLEANER, Mark II Dust Bug**, keeps records clean by removing dirt and dust that can settle on the surface of the record while in use. When the red pad of the *Dust Bug* is slightly dappened with an anti-static fluid, the pad collects dust and dirt is swept out the grooves by the *Dust Bug's* nylon brush. The *Dust Bug* also applies the proper degree of humidity to neutralize and prevent the generation of static electricity that attracts dust into the grooves.

The *Dust Bug* is furnished with a choice of two support mountings for simple attachment to the surface of any manual turntable or automatic turntable used in single play. Both the suction cup and PVC mounting are supplied. The PVC mounting base is provided for those turntables

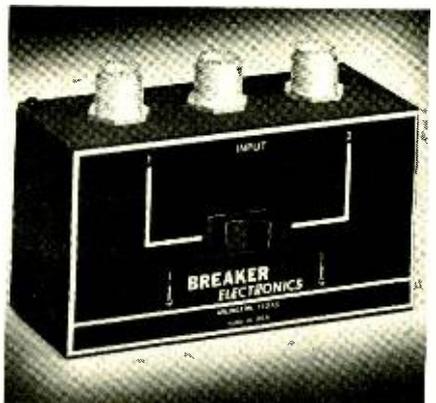
surfaces to which the suction cup will not adhere or where a more permanent mounting is



desired.—Elpa Marketing Industries, Inc., Watts Record Care Products, Thorens Bldg., New Hyde Park, NY 11040.

**CIRCLE 97 ON FREE INFORMATION CARD**

**CB COAX SWITCH, model 13-200**, permits changeover from single to duals, or other CB antenna arrangements by a simple flick of the switch. It has a single SO-239 transceiver input



connector and is switchable to either of the two SO-239 antenna cable connectors. The switch eliminates tedious changes in transmission-line connections and concern about proper impedance matching when it is desirable to use a different antenna. Measuring 4 3/4 x 2 1/2 x 2 inches, the unit is housed in a black metal case. List price is \$7.95.—Breaker Corp., Marketing Dept., 1101 Great Southwest Parkway, Arlington, TX 76011.

**CIRCLE 98 ON FREE INFORMATION CARD**

**CB CONVERTER, Roadmate model CBC-1**, converts ordinary car radio into CB receiver. After mounting the unit under the dashboard, plug the car's broadcast antenna into the unit, the unit's antenna connector into the car radio,



hook it up to your 12-volt car battery and the car radio tuning dial becomes the tuner that lets you select any of the 23 CB channels. CBC-1 features pushbutton on/off control and an LED

**Checklist of Books for the Libraries of Technicians, Hobbyists & Students**

**DIY AND NEW BOOKS—JUST PUBLISHED!**

- Master Tube Substitution Handbook. 322 p. \$4.95
- Modern Guide to Digital Logic. 294 p. 222 il. \$6.95
- VHF/UHF Fire, Police, Ham Scanners. 250 p., 114 il. \$6.95
- DP AMP Circuit Design & Applications. 280 p., 239 il. \$6.95
- Master Handbook of Digital Logic Applications. 392 p., 287 il. \$7.95
- CET License Handbook 2nd ed. 448 p., 381 il. \$8.95
- The Electronic Music Instrument Manual. 210 p., 385 il. \$6.95
- Microprocessor Microprogramming Handbook. 294 p., 176 il. \$6.95
- Color TV Trouble Facts—Problems Solutions 3rd ed. 434 p. \$5.95
- Sourcebook of Electronic Organ Circuits. 168 p., 101 il. \$4.95
- Build Your Own Working Robot. 238 p., 83 il. \$5.95
- Cber's Handbook of Simple Hobby Projects. 168 p., 114 il. \$3.95
- Fire & Theft Security Systems 2nd ed. 192 p., 114 il. \$5.95
- How to Repair Home Laundry Appliances. 280 p., 137 il. \$5.95
- Broadcast Engineering & Maintenance Handbook. 532 p. \$19.95
- Impedance. 196 p., 90 il. \$5.95
- Plotting Navigation With the Pocket Calculator. 392 p., 233 il. \$8.95
- Solid-State Color TV Photo-Symptom Guide. 224 p., 169 il. \$5.95
- Design Maintain CATV Small TV Studio 2nd ed. 288 p., 100 il. \$12.95
- Modern Electronics Math. 686 p., 424 il. \$9.95

**FOR THE HOUSEHOLD AND THE WORKSHOP**

- Homeowner's Guide to Saving Energy. 196 p., 183 il. \$5.95
- Customizing Your Van. 192 p., 150 il. \$3.95
- The Woodworker's Bible. 434 p., 1151 il. \$5.95
- Motorcycle Repair Handbook. 392 p., 260 il. \$6.95
- The Complete Handbook of Locks & Locksmithing. 392 p. \$6.95
- All About Swimming Pools. 182 p., 127 il. \$3.95
- Step-By-Step Guide: Carburetor Tuneup/Overhaul. 224 p. \$4.95
- Homeowner's Guide To Solar Heating & Cooling. 196 p. \$4.95
- Do-It-Yourselfer's Guide: Home Planning/Constr. 248 p. \$4.95
- Step-By-Step Guide to Brake Servicing. 238 p., 238 il. \$4.95
- Vega 350 p., 265 il. \$5.95
- Step-By-Step Guide: Chrysler Eng. Maint. Rpr. 256 p., 195 il. \$5.95
- Subcontract Your House: Bldg./Remodeling. 196 p., 63 il. \$4.95
- Auto Electronics Simplified. 256 p., 202 il. \$5.95
- The Complete Auto Electric Handbook. 210 p., 139 il. \$5.95
- Concrete & Masonry. 392 p., 213 il. \$5.95
- Home Appliance Clinic: Controls, Timers, Wiring/Rpr. 195 p. \$4.95
- Practical Home Constr. Carpentry Hdbk. 448 p., 180 il. \$5.95
- How to Repair Diesel Engines. 308 p., 237 il. \$5.95
- Central Heating & Air Cond. Repair Guide. 320 p., 285 il. \$6.95
- Small Appliance Repair Guide—Vol. 2. 210 p., 119 il. \$4.95
- Electrical Wiring/Lighting For Home Office. 204 p., 155 il. \$4.95
- How to Repair Small Gasoline Engines. 288 p., 124 il. \$5.95
- How to Repair Home/Auto Air Cond. 208 p., over 100 il. \$4.95

**ELECTRONICS TECHNOLOGY COMPUTERS/CALCULATORS**

- Master Hdbk of 1001 Prac. Electronic Circ. 602 p., 1250 il. \$9.95
- Intro to Medical Electronics. 2nd ed. 320 p., 126 il. \$7.95
- Computer Programming Handbook. 518 p., 114 il. \$8.95
- Computer Technician's Handbook. 480 p., over 400 il. \$8.95
- Microelectronics. 266 p., 228 il. \$5.95
- Basic Digital Electronics. 210 p., 117 il. \$4.95
- Switching Regulators & Power Supplies. 252 p., 128 il. \$6.95
- Advanced Applications for Pocket Calculators. 304 p., 275 il. \$5.95
- Tower's International Transistor Selector. 140 p. (7 x 10) \$4.95
- Electronic Conversions, Symbols & Formulas. 224 p., 252 il. \$4.95
- Effective Troubleshooting With EVM & Scope. 238 p., 185 il. \$5.95
- Getting the Most Out of Electronic Calculators. 204 p., 28 il. \$4.95
- Aviation Electronics Handbook. 406 p., 227 il. \$8.95
- How to Test Almost Everything Electronic. 160 p., 144 il. \$2.95
- Digital Logic Electronics Handbook. 308 p., 226 il. \$6.95
- Transistor Theory for Technicians/Engineers. 224 p., 116 il. \$9.95
- Modern Applications of Linear IC's. 276 p., 114 il. \$4.95
- 10-Minute Test Techniques For PC Servicing. 216 p., 114 il. \$4.95
- Electr. Unraveled—New Commonsense Approach. 228 p. \$4.95
- How to Tshoot Repair Electronic Test Eqpt. 252 p., 143 il. \$6.95
- Understanding & Using the Oscilloscope. 272 p., 170 il. \$5.95
- Industrial Electronics: Principles & Practice. 416 p., 380 il. \$8.95
- Dictionary of Electronics. 420 p., 487 il. \$4.95

**RADIO & TV SERVICING**

- Beginner's Guide to TV Repair. 176 p., 50 il. \$4.95
- Troubleshooting With the Dual-Trace Scope. 224 p., 252 il. \$5.95
- TV Troubleshooter's Handbook—3rd ed. 448 p., over 300 il. \$4.95
- Color TV Case Histories Illustrated. 238 p., 219 il. \$5.95
- TV Schematics: Read Between the Lines. 252 p., 188 il. \$5.95
- Logical Color TV Troubleshooting. 240 p., 151 il. \$4.95
- TV Bench Servicing Techniques. 228 p., 177 il. \$4.95
- Modern Radio Repair Techniques. 260 p., 36 il. \$4.95
- How to Interpret TV Waveforms. 256 p., 250 il. \$4.95
- Kwik-Fix TV Service Manual. 384 p., 100's il. \$5.95
- All-In-One TV Alignment Handbook. 304 p., 145 il. \$5.95
- TV Tuner Schematic/Servicing Manual. 224 p., 287 il. \$6.95
- 199 Color TV Troubles & Solutions. 224 p., 178 il. \$4.95
- How to Use Color TV Test Instruments. 256 p., 230 il. \$5.95
- Home-Call TV Repair Guide. 144 p., 20 il. \$3.95
- Pinpoint TV Troubles in 10 Minutes. 327 p., 394 il. \$5.95

**CB, COMMUNICATIONS & HAM RADIO**

- CB Schematic Servicing Manuals. each 200 p. \$5.95 Vol. 1 Kris Browning, Hy-gain, J.C. Penney, (Pinto) Vol. 2 Teaberry, Unimetrics, Pearce-Simpson, Sillitronix Vol. 3 E. F. Johnson (Messenger), SBE-Linear, Sonar, Royce Vol. 4 Pace

**FANON COURIER DYNASCAN (Cobra)**

- 2nd Class FCC Encyclopedia. 602 p., 445 il. \$7.95
- The Complete Shortwave Listener's Hdbk. 288 p., 101 il. \$5.95
- CB Radio Operator's Guide. 2nd ed. 256 p., 139 il. \$5.95
- Cber's Handy Manual. 48 p. \$1.50
- Cber's Handy Atlas/Dictionary. 64 p. \$1.95
- Pictorial Guide to CB Radio Install/Repair. 256 p., 304 il. \$5.95
- Practical CB Radio Troubleshooting & Repair. 238 p., 108 il. \$5.95
- The Complete FM 2-Way Radio Handbook. 294 p., 111 il. \$6.95
- Directional Broadcast Antennas. 210 p., 60 il. \$12.95
- Amateur FM Conversion & Construction Proj's. 256 p., 187 il. \$5.95
- Broadcast Ann'r. 3rd Class FCC Study Guide. 192 p., 19 il. \$3.95
- Modern Communications Switching Systems. 276 p., 171 il. \$17.95
- How To Be A Ham—including Latest FCC Rules. 192 p., 25 il. \$3.95
- Commercial FCC License Handbook. 444 p., 150 il. \$5.95
- The 2-Meter FM Repeater Circuits Handbook. 312 p., 194 il. \$6.95
- RTTY Handbook. 320 p., 230 il. \$6.95
- Citizens Band Radio Service Manual. 228 p., 84 il. \$5.95
- How to Become a Radio Disc Jockey. 256 p. \$9.95

**AMATEUR RADIO STUDY GUIDES:  Novice \$5.95  General \$7.95  Advanced \$5.95  Extra \$6.95  Incentive \$4.95**

**HOBBY ELECTRONICS**

- How to Read Electronic Circuit Diagrams. 132 p., 140 il. \$4.95
- 21 Simple Transistor Radios You Can Build. 140 p., 122 il. \$3.95
- Basic Electricity & Beginning Electronics. 252 p., 191 il. \$5.95
- Radio Control for Models. 350 p., 417 il. \$6.95
- MOSFET Circuits Guidebook. 196 p., 104 il. \$4.95
- Practical Circuit Design for the Experimenter. 196 p., 119 il. \$4.95
- 111 Digital & Linear IC Projects. 210 p., 275 il. \$5.95
- Radio Astronomy for the Amateur. 252 p., 96 il. \$5.95
- Build-It Book of Mini Test Measurement Instr. 238 p., 151 il. \$4.95
- RF & Digital Test Equipment You Can Build. 252 p., 217 il. \$5.95
- Miniature Projects For Electronic Hobbyists. 168 p., 77 il. \$3.95
- Practical Triac/SCR Projects For The Exp. 192 p., 146 il. \$4.95
- RC Modeler's Handbook of Gliders & Sailplanes. 196 p. 90 il. \$4.95
- Integrated Circuit Guidebook. 196 p., 119 il. \$5.95
- Solid-State Circuits Guidebook. 252 p., 227 il. \$5.95
- Model Sail Power Boating... by Remote Control. 192 p., 125 il. \$4.95
- Electronics For Shutterbugs. 204 p., 109 il. \$5.95
- Practical Test Instruments You Can Build. 204 p., 157 il. \$4.95
- How to Build Solid-State Audio Circuits. 320 p., 190 il. \$5.95
- Radio-Electronics Hobby Projects. 192 p., 214 il. \$4.95
- Handbook of IC Circuit Projects. 224 p., 136 il. \$4.95
- Solid-State Projects for the Experimenter. 224 p., 228 il. \$4.95
- Electronic Experimenter's Guidebook. 182 p., 86 il. \$4.95
- 125 One-Transistor Projects. 192 p., 125 il. \$4.95
- 104 Easy Projects for Electronic Gadgeteers. 160 p., 105 il. \$3.95
- 64 Hobby Projects for Home & Car. 192 p., 159 il. \$4.95

**AUDIO, HI-FI & ELECTRONIC MUSIC**

- Electronic Music Circuit Guidebook. 224 p., 180 il. \$6.95
- Questions & Answers About Tape Recording. 264 p., 102 il. \$5.95
- Handbook of Multichannel Recording. 322 p., 196 il. \$7.95
- Auto Stereo Service & Installation. 252 p., 245 il. \$5.95
- Basic Audio Systems. 240 p., 203 il. \$4.95
- Servicing Cassette & Cartridge Tape Players. 294 p., 196 il. \$5.95
- Electronic Music Production. 156 p., 79 il. \$3.95
- FM Stereo Quad Receiver Servicing Manual. 192 p., 130 il. \$4.95
- Experimenting With Electronic Music. 180 p., 103 il. \$4.95
- Cassette Tape Recorders, How Work/Care/Repair. 204 p. \$4.95
- Acoustic Techniques for Home & Studio. 224 p., 168 il. \$5.95
- Pictorial Guide to Tape Recorder Repairs. 256 p., 320 il. \$4.95
- How to Repair Musical Instrument Amplifiers. 288 p., 50 il. \$5.95
- Japanese Radio, Record, Tape Player Srvcc. Manual. 228 p. \$6.95
- Servicing Electronic Organs. 196 p., 158 il. \$7.95
- Tape Recording for Fun & Profit. 224 p., over 200 il. \$5.95

**ALL-IN-ONE COLOR & B&W TV SCHEMATIC/SERVICING MANUALS**

Each vol. has complete service data, parts lists, full-size schematics, and all other info needed. Each 8 1/2 x 11" 196, 212 pgs. Each only \$4.95 unless marked. COLOR TV: Adm. Vol. 1 \$5.95 Vol. 2 \$6.95 GE Vol. 1 \$5.95 Vol. 2 \$5.95 Jap. Vol. 1 \$5.95 Vol. 2 Vol. 3 Vol. 4 \$5.95 Vol. 5 \$5.95 Mag. Vol. 1 Vol. 2 Vol. 3 \$5.95 Philco \$5.95 RCA Vol. 1 \$5.95 Vol. 2 \$5.95 Vol. 3 \$5.95 Vol. 4 \$5.95 Vol. 5 \$5.95 Sears \$5.95 Serv. Modular Rec'r Vol. 1 \$6.95 Vol. 2 \$6.95 Vol. 3 \$5.95 Toshiba \$5.95 Zenith Vol. 1 \$5.95 Vol. 2 \$5.95 Vol. 3 \$5.95 Vol. 4 \$5.95 B&W TV: Adm. \$7.95 GE \$7.95 Jap. \$6.95 Mag. \$6.95 No. Philco RCA \$7.95 Sylvania Zenith \$7.95

**NO RISK COUPON-MAIL ENTIRE AD**

TAB BOOKS, Blue Ridge Summit, Pa. 17214  
Please send me books checked above.

I enclose \$\_\_\_\_\_ send postpaid  
 Please invoice on 10-day FREE trial.

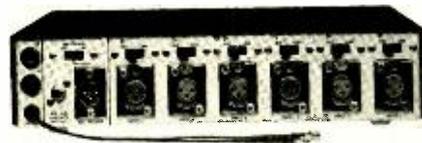
Name \_\_\_\_\_ Phone \_\_\_\_\_  
Company \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_  
SAVE POSTAGE by remitting with order. Foreign add 10% Pa. residents add 6%. RE-106

**CIRCLE 20 ON FREE INFORMATION CARD**

to indicate that the unit is on and operating. A flick of the switch and the car radio will receive ordinary broadcast stations. Priced at \$29.95, the unit comes complete with installation and operating instructions.—**EICO Electronic Instrument Co., Inc.**, 283 Malta Street, Brooklyn, NY 11207.

**CIRCLE 99 ON FREE INFORMATION CARD**

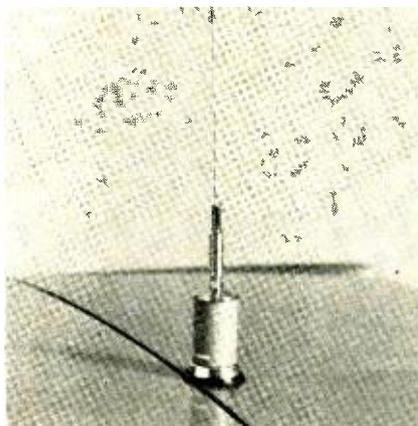
**MICROPHONE MIXER, model M677**, adds six additional low-impedance balanced microphone inputs to a sound system. Specifications include: frequency response,  $\pm 2$  dB from 30 Hz to 20,000 Hz; equivalent input noise,  $-128$  dBV, 300 to 20,000 Hz noise bandwidth at full gain; equivalent input hum-and-noise,  $-125$  dBV, 30 to 20,000 Hz noise bandwidth at full gain; distortion less than 1% THD at 1,000 Hz; low-cut filters,  $-6$  dB at 1,000 Hz typical.



The new M677 mixer can be powered from the nominal 28–30-volt DC output of the attached master mixer or from a Shure A67B battery power supply. Measures  $11\frac{3}{8} \times 7 \times 2\frac{1}{2}$  inches, weighs  $3\frac{3}{4}$  pounds and sells for \$181.20—**Shure Bros., Inc.**, 222 Hartrey Avenue, Evanston, IL 60204.

**CIRCLE 100 ON FREE INFORMATION CARD**

**MOBILE CB ANTENNA, model M-510**, can be permanently mounted on a trunk lid with no holes by using the handy grip trunk-lid mount. It



also converts easily for roof-top mounting. \$36.75.—**The Antenna Specialist Company**, 12435 Euclid Avenue, Cleveland, OH 44106.

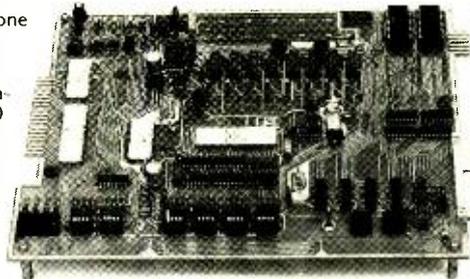
**CIRCLE 101 ON FREE INFORMATION CARD**

**CB LOCK-MOUNT, model 301C**, features heavy-gauge steel construction with key lock for protection. Contact wiring is provided for transceiver, remote CB speaker and public address. Coaxial antenna leads come complete with PL-259 connector and threaded antenna connector post.

Removal of transceiver from car, truck or van is simple operation. Lock mount is all black

## If you want a microcomputer with all of these standard features...

- 8080 MPU (The one with growing software support)
- 1024 Byte ROM (With maximum capacity of 4K Bytes)
- 1024 Byte RAM (With maximum capacity of 2K Bytes)
- TTY Serial I/O
- EIA Serial I/O
- 3 parallel I/O's
- ASCII/Baudot terminal compatibility with TTY machines or video units
- Monitor having load, dump, display, insert and go functions



- Complete with card connectors
- Comprehensive User's Manual, plus Intel 8080 User's Manual
- Completely factory assembled and tested—not a kit
- Optional accessories: Keyboard/video display, audio cassette modem interface, power supply, ROM programmer and attractive cabinetry... plus more options to follow. **The HAL MCEM-8080, \$375**

## ...then let us send you our card.

HAL Communications Corp. has been a leader in digital communications for over half a decade. The MCEM-8080 microcomputer shows just how far this leadership has taken us...and how far it can take you in your applications. That's why we'd like to send you our card—one PC board that we feel is the best-valued, most complete



microcomputer you can buy. For details on the MCEM-8080, write today. We'll also include comprehensive information on the HAL DS-3000 KSR microprocessor-based terminal, the terminal that gives you multi-code compatibility, flexibility for future changes, editing, and a convenient, large video display format.

**HAL Communications Corp.**  
Box 365, 807 E. Green Street, Urbana, Illinois 61801  
Telephone (217) 367-7373

**CIRCLE 79 ON FREE INFORMATION CARD**

# Money Generator

PAT. PEND. \$299.95

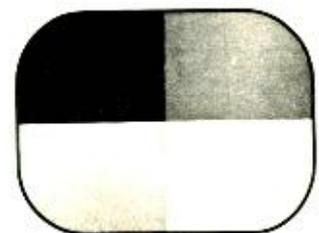


## ATC-10 GENERAL TELEVISION SERVICER

- Extra wide range RF/IF attenuator for testing receiver sensitivity.
- HATCHDOTS - versatile composite pattern for dynamic & static convergence plus other checks.
- COLOR BARS pattern with 6th bar marked to make your job easier.
- 3.58 MONITOR pattern for oscillator frequency checks with no need to short the AFPC test point.
- RED RASTER pattern for checking and adjusting purity at the flip of a switch.
- High level, 75 ohm output provided.
- ◆ 2 year factory warranty.
- ◆ 30 day money back guarantee.
- ◆ 2 volume owner's manual available separately - \$1.00.

# Unique

One of the most useful, UNIQUE patterns of the ATC-10 is the GRAY QUAD pattern below. Use it for checking and adjusting gray scale tracking or for checking effects of video level upon horizontal sync. Use it to check for reversed yoke connections - vertical, horizontal or both. Use it to check low frequency video response. *It can save you time, trouble and money!* Write us.



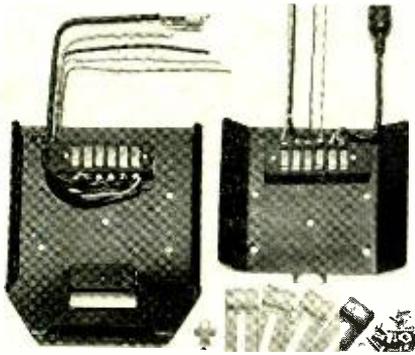
**American Technology Corporation**

225 Main Street, Dept. 10C, Canon City, Colorado 81212

Credit card & COD phone orders accepted. Same day shipment. (303) 275-8991, ext. 3.

**CIRCLE 45 ON FREE INFORMATION CARD**

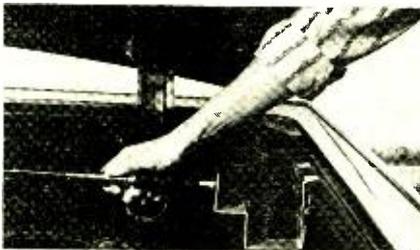
color providing minimum attention to CB unit.—



Electronics Industries, Inc., 333 Taft Drive, So. Holland, IL 60473.

CIRCLE 102 ON FREE INFORMATION CARD

**CB ANTENNA, Tuk-A-Way**, installs easily on the trunk lip of most cars, and provides complete antenna concealment inside the trunk when not in use. It accepts antennas designed for either roof or trunk mounting. Built of 12-gauge cold-



rolled steel coated with zinc chromate. The hinge is of stainless steel and is spot-welded to the clamp to provide a positive ground contact.

\$15.95, with a one-year limited warranty.—Deep South Marketing Corp., 2828 Telephone Road, Houston, TX 77023. R-E

CIRCLE 109 ON FREE INFORMATION CARD

### Computers show motorists the way around traffic jams

Traffic-control computer systems, used for years in many cities, are now being tried on intercity highways. An experimental system in the Rhine-Main area in Germany, where the highways handle traffic between several large cities, shows considerable promise. The system is designed to spot areas of extra-heavy traffic—potential traffic jams—and direct vehicles to alternate "relief" routes to avoid such a situation.

Special detectors imbedded in the road collect information on the number of vehicles passing, their speed and whether they are passenger cars or trucks. (It is important to distinguish between cars and trucks wherever there is a possibility that the traffic may be diverted to routes with uphill gradients.)

The information collected on the various roads is reported to the traffic control center, where a Siemens 16030 traffic control computer evaluates the data, displays the information on a video display unit and reroutes traffic to other roads wherever the load is extremely heavy or is moving rapidly toward such a situation so that the situation can be avoided.

The rerouting is done with a series of roadside signs. These are set up in sets of three—two advance and one main sign—to give motorists ample warning of the

turnoff. The three signs of a set are not changed simultaneously, but consecutively, at a rate depending on the average speed of traffic. Otherwise a sign change might cause a motorist to receive one routing recommendation at the first sign he sees and a contrary one at the next sign.

During the experimental period, the control computer has not been allowed full control over actual traffic. The rerouting decisions are first displayed, then scanned by a human traffic expert before the variable relief-route signs are acti-



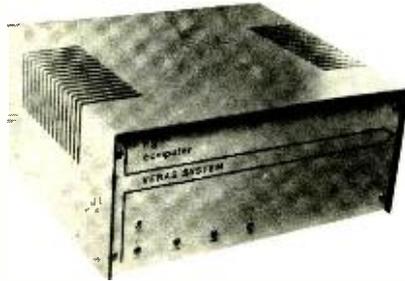
AN ALTERNATE ROUTE is recommended to Dortmund-bound motorists, and the sign also tells them the distance to the turnoff point.

ated. The system will become fully automatic as soon as enough knowledge has been gained to bring the computer programming to a point that will assure near-perfect traffic control. No projection is made as to how long that may take. R-E

### A COMPLETE 1K RAM SYSTEM FOR ONLY \$459.00 IN KIT FORM \$709.00 ASSEMBLED & TESTED

With CPU card, buffered mother card, power supply as described below and cabinet. The VERAS System is developed around the popular F-8 Series of chips which in our estimation is the finest and most versatile Micro Processor now available.

The VERAS System can be made into a 17K processor by merely adding four of our optional memory boards. The kit includes everything you need to build the VERAS F-8 Computer as described. All boards, connectors, switches, discrete components, power supply and cabinet are supplied. Programming manual, data book and simplified support documentation supplied. 8K Assembler and Editor (paper tape) available on request with minimum order of 8K RAM.



7" x 16" x 14-3/4"

### OUR 4K STATIC RAM BOARD FEATURES: (OPTIONAL)

- Outputs buffered.
- On board decoding for any four of 64 pages.
- Address and data lines are fully buffered.
- 32 2102-1 static RAM's, 500 ns. or less, requiring no refreshing.
- No onboard regulators to cause heat problems (Chassis mounted)
- 4K memory boards with connector, buffers and static RAM's are available in kit form for \$149.00

The fully buffered mother board will accept (4) 4K RAM boards for a total of 16K bytes of memory. Individual power terminals for each 4K RAM board are provided. Memory expansion beyond 16K bytes can be accomplished by the addition of more mother boards. Extra buffered mother boards with connector are available in kit form for \$45.00

Our modular power supply is designed around a high frequency toroid transformer, which affords a large saving in size and weight, and keeps filtering to a minimum. It is rated at +5V at 10 amps and -5V and +12V at 1 amp. This power supply will drive our CPU, four memory boards and some peripherals.

POWER SUPPLY KIT \$139.00

All boards are high quality G 10, double sided, solder plated with gold plated edge connector.

### PACKAGING FEATURES ARE:

- A) Complete modular plug in construction
- B) Specifically designed rugged aluminum card rack with provisions for voltage regulators (TO-220 supplied) to keep heat off the boards
- C) Designed for convection or optional forced cooling.
- D) All I/O ports brought out to the rear panel connectors for easy accessibility
- E) Auxiliary DC power available at the rear panel to power peripherals.

Veras Systems is currently developing the following:

UV PROM board, DMI and DMA board, Cassette, modem, video board and more. All these boards will have innovative design, something you will come to expect from VERAS SYSTEMS

Computer dealers and hobbyist club inquiries are invited.

Expected delivery time 30 days or less.

CIRCLE 57 ON FREE INFORMATION CARD

## THE VERAS F8 COMPUTER

THE SYSTEM DESIGNED WITH THE USER IN MIND

FOR BOTH COMMERCIAL & HOBBYIST USE

### THE CPU BOARD FEATURES:

- Two I/O ports each on the CPU and ROM chip make 32 bidirectional TTI lines.
- The Fairbug\* programmed storage unit provides the programmer with all I/O subroutines, allows the programmer to alter or display memory, and register its contents via teletype.
- Programmable internal timer is built into the ROM chip.
- Built in clock generator and power on reset are built into the CPU chip.
- There is a local interrupt with automatic address vector
- It is expandable to 65K bytes of memory.
- 20 mil loop and/or RS232 interface included
- 1K of on board 2102 RAM.
- Serial interface built into PSU chip

The More Flexible and Expandable Computer at a Comparative Price.

## VERAS SYSTEMS

Warranty: 90 days on parts and labor for assembled units 90 days on parts for kits. Prices, specifications and delivery subject to change without notice

\*Fairbug is a registered trademark of Fairchild Corp.

### VERAS SYSTEMS

A Div. of Solid State Sales, Inc.  
Box 74D, Somerville, MA 02143  
(617) 547-1461

Enclosed is check for \$ \_\_\_\_\_  
or  Master Charge # \_\_\_\_\_

VERAS F-8 Computer Kit  Assembled  
 4K Ram Board Qty \_\_\_\_\_  
 Power Supply Kit

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City, State \_\_\_\_\_ Zip \_\_\_\_\_

# new lit

More information on new lit is available from the manufacturers of items identified by a Reader Service number. Use the Free Information Card following page 116.

**OSCILLOSCOPES.** 12 pages of pictures, facts and specifications on the six oscilloscopes that make up this manufacturer's T900 series. All units in this series have an 8 x 10 centimeter display area and 2 units are storage scope models.—**Tektronics Inc.**, P.O. Box 500, Beaverton, OR 97077

**CIRCLE 103 ON FREE INFORMATION CARD**

**SERVICE TECHNICIAN AND INDUSTRIAL CATALOG.** 336 pages loaded with all kinds of devices for the service technician. Everything in the GC, Telco, Walsco, Calectro, Electrocraft, and Audio-tex lines. In addition, a complete section of CB-equipment. This is one catalog that every service technician should have.—**GC Electronics**, Rockford, IL 61101

**CIRCLE 104 ON FREE INFORMATION CARD**

**ELECTRONIC TEST ACCESSORIES.** 76 pages of plugs, patch cords, cable assemblies, test socket adapters, space molded accessories, test leads, connecting leads, and IC test clips. Special charts covering a cross index of type numbers includes

description of various wire and cable types.—**Pomona Electronics**, 1500 East Ninth St., P.O. Box 2767, Pomona, CA 91766

**CIRCLE 105 ON FREE INFORMATION CARD**

**TEST INSTRUMENTS** of many different varieties are described and illustrated in this 40-page booklet. There's everything from CB radio test instruments, to curve tracers, to FET multimeters, to oscilloscopes, plus signal and marker generators, tube testers and vectorscopes. A valuable guide to this manufacturer's line of test equipment and accessories.—**B&K Precision Instruments**, 6460 W. Cortland, Chicago, IL 60635

**CIRCLE 106 ON FREE INFORMATION CARD**

**REPLACEMENT TUNER GUIDE** and parts catalog. Extensive listing of all major makes and models of tuners and replacement parts. Includes photo enlargements of tuners for quick detection of a tuner problem and easy location of the correct replacement part. The new catalog is available for \$2.00 and has 134 pages.—**PTS Electronics, Inc.**, 5233 S. Hwy. 37, Bloomington, IN 47401

**CIRCUIT DESIGN LINE.** A 24-page illustrated catalog that shows a complete line of Solderless Breadboards and Breadboard IC Testers in a number of varieties along with many useful accessories.—**E & L Instruments, Inc.**, 61 First St., Derby, CT 06418

**CIRCLE 107 ON FREE INFORMATION CARD**

**TAPE & PHONO DRIVE & BELTS CATALOG,** catalog WA-00CG-0290. A complete guide to exact replacement of drives and belts for cassette, cartridge, recorder/player, and phonographs. The *Walsco Tape & Phono Exact Replacement Drives & Belts Catalog* illustrates and describes the entire line of exact replacement units, as well as containing a cross-reference guide to more than 200 manufacturers. The line includes fabric belts, square belts, "O rings," drive wheels, pressure rollers, turret drives, and switches.—**G.C. Electronics**, Division of Hydrometals, Inc., 400 South Wyman Street, Rockford, IL 61101.

**CIRCLE 110 ON FREE INFORMATION CARD**

## Consumer Tested Remedy for Sick Car Performance Sparks New Life in Pre-1975 Cars.

Owners of pre-1975 cars get better performance with less maintenance when they install one of the Mark Ten C.D. Electronic Ignition Systems. In fact, thousands of users testify the Mark Ten has noticeably improved their automobile's performance. As a California doctor stated after using the Mark Ten for 95,000 miles. "...I can 'feel' the difference in performance between my conventional ignition and the Mark Ten..."



Mark Ten Systems\* spark each plug with 50,000 to 60,000 volts in secondary output compared to a mere 25,000 volts in standard and most pointless systems. This means dramatic increases in acceleration and general engine performance, and substantial increases in gasoline mileage. Points will last the lifetime of the rubbing block. Spark plug life is extended three to ten times due to the hot spark generated by the Mark Tens, which eliminates fouling and cleans dirty plugs. And the Mark Ten Systems virtually eliminate at least 2 out of 3 tuneups! Look at what Delta Customer P.S. from New York wrote, "...I might add that I had another unit of yours that has been on three cars so far. Each of the cars was driven about 50,000 miles

before it was turned in. *Not one of the cars ever had a new set of points, new plugs or a tune-up.*

Now its on the fourth car with 20,000 miles on it and going strong." The result? **BIG SAVINGS!**

Send today for your copy of the new Delta brochure and learn how a Mark Ten System can spark your car into new life.

\*Only Delta Products offers a full line of C.D. ignitions: The Mark Ten and Mark Ten B, available assembled or in kit form; and the Mark Ten C, assembled only.

**DELTA PRODUCTS, INC.**  
P.O. Box 1147  
Grand Junction, Colo. 81501  
(303) 242-9000 Dept. RE

I want to know more about Mark Ten CDI's. Send me complete no-nonsense information on how they can improve the performance of my car.

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

**CIRCLE 23 ON FREE INFORMATION CARD**

**LEARN QUICKLY—EASILY—AT HOME**  
**Only I.H.S.I. offers these unique**  
**correspondence courses**  
**MATHEMATICS ■ ELECTRONICS ■**  
**ENGINEERING MATHEMATICS ■ ADVANCED MATHEMATICS ■**  
**ADVANCED ENGINEERING MATHEMATICS ■**

These unusual courses are the result of many years of research and teaching by the President of INDIANA HOME STUDY INSTITUTE, who has *personally* lectured in the classroom to *thousands* from all walks of life on mathematics, electrical and electronic engineering.

- You must see these lessons to appreciate them!
- NOW you can master mathematics and electronics and actually *enjoy* doing it!
- WE ARE THIS SURE:—you order your lessons on a *money-back guarantee*.
- In plain language, *if you aren't satisfied you don't pay a cent*.

There are no strings attached.

WRITE TODAY for more information and your outline of courses. You have everything to gain and nothing to lose!

LICENSED BY THE STATE BOARD OF INDEPENDENT POST-SECONDARY VOCATIONAL, TECHNICAL, TRADE AND BUSINESS SCHOOLS.

**THE INDIANA HOME STUDY INSTITUTE**  
**EASTERN DIVISION**  
**P.O. BOX 1189**  
**PANAMA CITY, FLA. 32401**

CIRCLE 12 ON FREE INFORMATION CARD

# Incredible counter!

## Incomparable price!

A 500mHz (6-Digit) FREQUENCY COUNTER for under 40 cents per mHz! Figure it out. It adds up to unheard-of savings! With guaranteed quality to match and exceed overpriced brands. Let us prove it to you now!

**169<sup>95</sup>**  
 \$199.95 assembled

(6-DIGIT/500mHz KIT)  
 FREQUENCY COUNTER



Perfect for: CBers, Hams, Service Techs, & Experimenters!

- HAM, CB, & COMMERCIAL BANDS • WIRED & TESTED AVAILABLE • 100HZ READOUT • 6 DIGITS
- CRYSTAL TIME-BASE • 1Hz OPTIONAL • MASTER CHG. / B. AMERICARD OK • ADD \$2 SHIPPING

**Hufco**

Incredible counters starting at \$45.95 are also available!  
 All counters can be factory wired and tested. Write or call today!  
 Box 357, Dept. 62, Provo, UT 84601 (801) 375-8566

CIRCLE 66 ON FREE INFORMATION CARD

**OVERSPEED ALARMS**  
*continued from page 47*

complete, the system can be removed from the vehicle and returned to the workshop for the fitting of R9 and C3.

The next step is to consult the graph of Fig. 8 to find the frequency or frequencies that correspond to the desired "alarm" RPM setting or settings. If these frequencies are referred to as  $f_{\text{ring}}$ , the value (or values) of R9 can be calculated on the basis of:

$$R9 = \left( \frac{150,000,000}{f_{\text{ring}}} \right) - R7, \text{ when}$$

C3 = .01  $\mu$ F and R7 is the calculated or measured value of resistance when C2 = .01  $\mu$ F.

Thus, in our example, which needs a 470 K value of R7 to give an 8,000 RPM value at 267 Hz, R9 needs a value of about 176 K to sound the alarm at 7,000 RPM, 280 K to sound it at 6,000 RPM, or 650 K to sound it at 4,000 RPM. If desired, these values can in practice be reduced by a factor of ten and the value of C3 increased to 0.1  $\mu$ F.

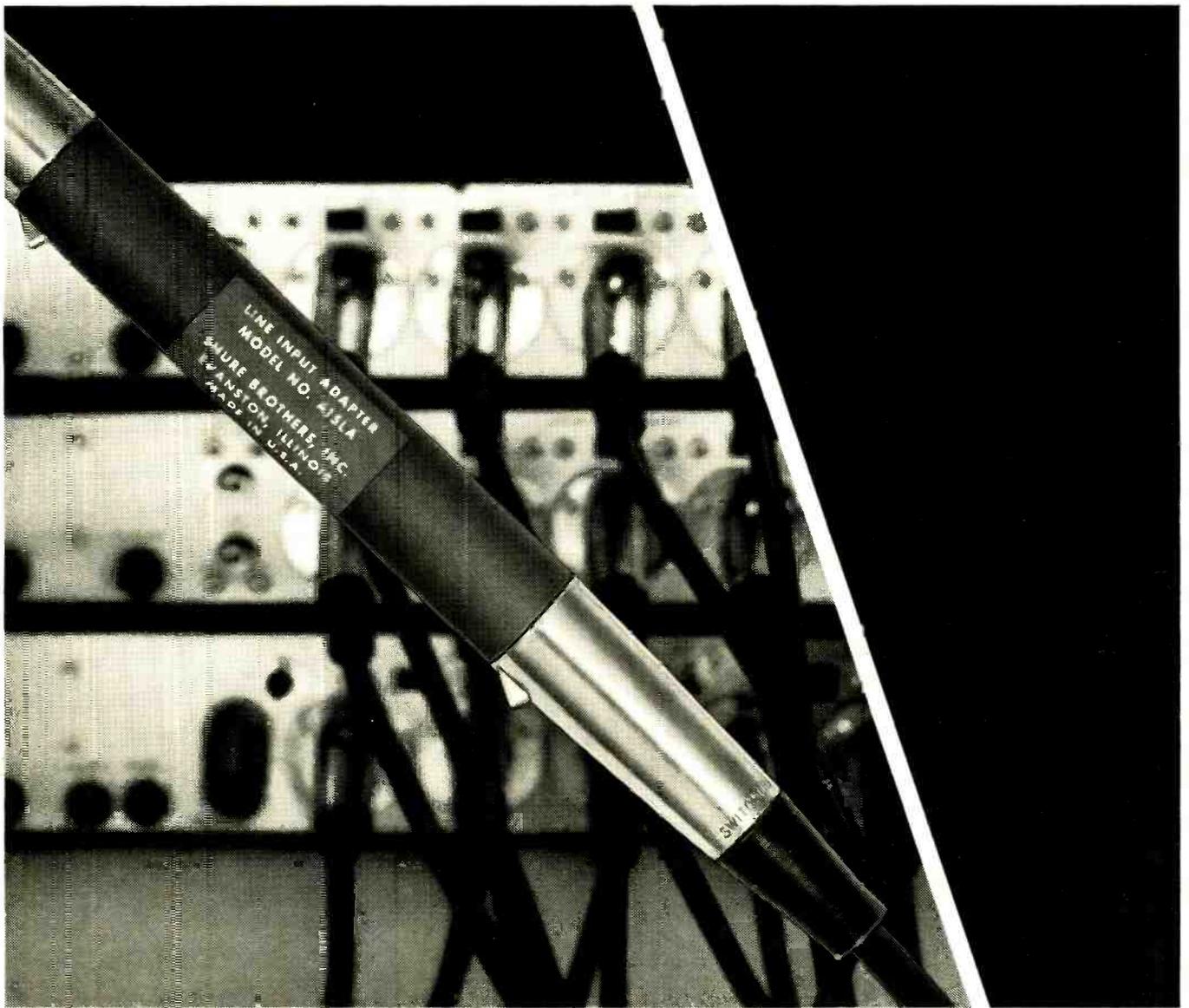
Once the values of R9 and C3 have been calculated, C3 can be wired permanently into place in the circuit, and R9 can be made up from a fixed and a variable resistor and wired temporarily into place. The R9 value or values can then be finally adjusted in the same way as R7.

The actual method is to connect the unit to a 12-volt supply, feed a suitable trigger signal of the calculated frequency,  $f_{\text{ring}}$ , across the R2-R3 combination, and then adjust R9 so the alarm just triggers at that precise frequency: If necessary, modify the value of the fixed part of R9 so that triggering can be obtained at the specified frequency.

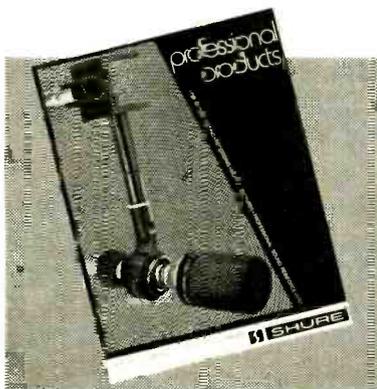
Once the setting (or settings) of R9 is complete, the resistor can be permanently wired into place in the circuit. Calibration of the tachometer and the alarm system is then virtually complete, and the unit can be wired into the vehicle on a permanent basis.

The unit should then be given at last check to ensure that its calibration is correct, and any necessary final adjustments made. It is then ready for use. If desired, the actual 1-mA moving-coil tachometer can be finally discarded at this stage, and replaced by a short circuit. R-E

**Red Cross.**  
**The Good Neighbor.**



## Solve 9 problems in seconds!



Eliminate hours of on-the-job rewiring with the Shure A15 series of plug-in line adapters, each of which can be put to use in seconds. For a small outlay, you can have any of the nine Shure miracle workers: Model A15A prevents input overload; A15LA converts a mic input to a line input; A15HP minimizes low frequency rumble; A15LP cuts off high frequency noise; A15PA adds extra brilliance and "presence"; A15RS filters sibilant sounds; A15PR reverses the phase of a line; A15BT matches impedances; and A15TG generates a trouble-shooting tone in scrambled wires. Read about these A15's in our catalog and we promise to save you hours of work.

Shure Brothers Inc.  
222 Hartrey Ave., Evanston, IL 60204  
In Canada: A. C. Simmonds & Sons Limited



Manufacturers of high fidelity components, microphones, sound systems and related circuitry.

CIRCLE 82 ON FREE INFORMATION CARD

OCTOBER 1976

107



INTERNATIONAL FM 2400CH

## FREQUENCY METER for testing mobile transmitters and receivers



- Tests Predetermined Frequencies 25 to 1000 MHz
- Extended Range Covers 950 MHz Band
- Pin Diode Attenuator for Full Range Coverage as Signal Generator
- Measures FM Deviation

The FM-2400CH provides an accurate frequency standard for testing and adjustment of mobile transmitters and receivers at predetermined frequencies.

The FM-2400CH with its extended range covers 25 to 1000 MHz. The frequencies can be those of the radio frequency channels of operation and/or the intermediate frequencies of the receiver between 5 MHz and 40 MHz.

Frequency Stability:  $\pm .0005\%$  from  $+50^\circ$  to  $+104^\circ\text{F}$ .

Frequency stability with built-in thermometer and temperature corrected charts:  $\pm .00025\%$  from  $+25^\circ$  to  $+125^\circ$  (.000125% special 450 MHz crystals available).

Self-contained in small portable case. Complete solid state circuitry. Rechargeable batteries.

FM-2400CH (meter only) ..... \$595.00  
 RF crystals (with temperature correction) ... 24.00 ea.  
 RF crystals (less temperature correction) .... 18.00 ea.  
 IF crystals ..... catalog price



International Crystal Manufacturing Company, Inc.  
 10 North Lee, Oklahoma City Oklahoma 73102

CIRCLE 39 ON FREE INFORMATION CARD

### MULTIPLE PIX

All I can get on this Philco 21HT15 is three or more pictures, overlapping! Everything else seems to be normal. I checked AFC diodes, capacitors and tube. Waveforms all funny. The horizontal hold works normally. What do you think this is?—G.L., Bronx, NY.

I think your horizontal oscillator is running off frequency. In fact, I will go so far as to say that it definitely is! It is running, or you wouldn't have a picture at all. If you checked the capacitors across the coil as you said, this leaves only one real good possibility. This is the horizontal hold coil itself. Check resistance of the windings and above all, make sure that the adjustable core hasn't been turned away too far in or out! Kill the AFC and adjust this for a single floating picture.

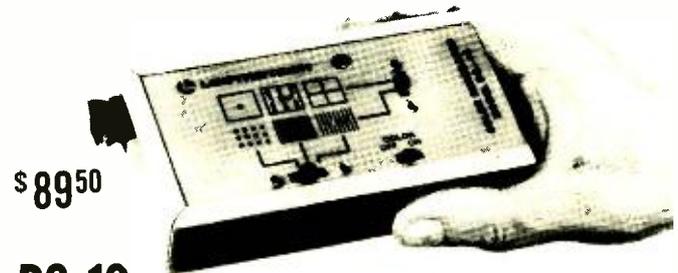
(Feedback: This did it! The coil checked OK but when I turned the core it was binding! I thought that I had reached the end of rotation but I hadn't! Thanks!)

### CAPACITOR BURNING

This RCA CTC-44 came in with the circuit breaker tripping. I found the cause to be C3 (Sams number; C403 RCA), a .072  $\mu\text{F}$  600-volt type. I replaced it with a .075- $\mu\text{F}$ . In about 15 minutes the same thing happened and the new capacitor burnt up. Tried another one and it got very hot in just a few minutes! Checked waveforms; all looked fairly good. Then my scope went out! Shorted power transformer. Any ideas?—C.G., Staten Island, NY.

There are days when it doesn't pay to get out of bed. aren't there? I've had 'em. Anyhow, I think I know what this is. Don't use a standard bypass capacitor in places like this. They will not carry the high RF current that is necessary. Use an exact duplicate replacement which will be a high-current type, very likely with polycarbonate insulation. This is getting to be pretty common, so watch out for similar circuits in other sets. (Triad and Thordarson have power transformers.) R-E

## MINI-BAR<sup>®</sup> color generator



\$8950

### BG-10 battery-operated, fits in shirt pocket!

No AC plug in . . . automatic on & off with LED indicator . . . fast, easy hook-up with coaxial cable . . . all essential patterns . . . • Low power consumption for extended battery life (Uses inexpensive 9 volt batteries) • Shuts off when not in use • Enclosed RF cable compartment • Size: 5 1/2" x 3" x 1 1/8". Only 12 ounces • TV station type sync signals • CMOS LSI IC for all counting functions . . . no internal adjustments • RF output on Ch. 3, 4 or 5.

BG-10 (less battery) ..... \$89.50  
 CC-1 Carrying Pouch ..... \$ 2.95

See your distributor or write  
**LECTROTECH, INC.**  
 5810 N. Western Ave.  
 Chicago, Illinois 60659  
 (312) 769-6262

CIRCLE 64 ON FREE INFORMATION CARD

# MONEY SAVING BUYS

FREE \$1 BUY WITH EVERY 10 YOU ORDER  
Only applies to "\$1" Buys

FREE GIFT WITH EVERY ORDER  
CANADIANS: Ordering is easy—we do the paperwork—try a small order

**RCA 110° FLYBACK TRANSFORMER**  
We scooped the Market. Latest type standard for all 110° TV's (Blk. & Wht.). RCA's design of large Coil produces 18KV—assuring adequate width Incl. Schematic Diagram application for any TV.  
List price \$13.90  
Your price ..... **3.95**  
10% off in lots of 3.



- 110° TV DEFLECTION YOKE for all types TV's Incl schematic ..... **4.95**
- "COMBINATION SPECIAL" RCA 110° FLYBACK plus 110° DEFLECTION YOKE ..... **6.95**
- 90° FLYBACK TRANSFORMER for all type TV's (Blk. & Wht.) ..... **2.95**
- 70° FLYBACK TRANSFORMER for all type TV's (Blk. & Wht.) ..... **2.00**
- 70° TV DEFLECTION YOKE for all type TV's (Blk. & Wht.) ..... **2.00**
- OLYMPIC & SHARP FLYBACK Part #8FT592 Equip. Stancor #HO-408 ..... **2.00**
- Thordarson #FY339 ..... **2.00**
- 90° COLOR YOKE For all Rectangular 19 to 25" Color CRT's ..... **7.95**
- 70 COLOR YOKE For all round color CRT's ..... **5.95**
- DELMONICO NIVICO COLOR FLYBACK Part #A20411-B ..... **7.95**
- WESTINGHOUSE FM TUNER #476-V-015D0 1 Transistor ..... **3.99**
- WESTINGHOUSE FM TUNER (12D78 Tube) ..... **1.00**
- UHF TUNER—Transistor Type Used in all TV sets ..... **2.95**
- G.E. UHF TUNER—TRANSISTOR TYPE Model #35X4 ..... **3.95**
- ADMIRAL TV TUNER Model #94C393-1 (2HA5-4LJ8) ..... **7.95**
- Model #T94C411-3 (Transistor) ..... **7.95**
- WELLS GARDNER TUNER Part #7A 120-1 (4GS7-2HA7 Tubes) ..... **7.95**
- G.E.—TV TUNER (2GK5-4LJ8) Model #EP 86x11 ..... **9.95**
- PHILCO UHF/VHF TUNER Transistorized ..... **9.95**
- 100° GREY SPEAKER WIRE 2 Cond., mini zip, 101 uses ..... **2.00**
- UNIVERSAL TV Antenna Back of set mounting . . . 5 section rods ..... **2.99**
- BLUE LATERAL Magnet Assy. Replacement for most color TV's ..... **1.79**
- 5-10K-2 WATT BIAS POTS Used in solid state application ..... **1.00**
- COLOR CONVERGENCE Assy. Universal type—good for most sets ..... **2.49**
- 3 SPEAKER—7 WAY SELECTOR SWITCH Wall Mount ..... **1.00**
- 7 TUBE AM-FM STEREO AMPLIFIER CHASSIS. Completely assembled—with tubes AS IS needs slight adjustments ..... **9.95**
- 10-MINI ELECTROLYTIC Cond For Transistor—miniature work MATCHED PAIRS ..... **1.00**
- TRANSISTORS NPN & PNP (2N4252 2N2904) (2N2222-2N2907) Each set ..... **1.00**
- ZENITH TV TUNER Model 175-1164 & 175-1151 (Parallel) ..... **9.95**
- Model 175-1120 & 175-1118 (Series) ..... **9.95**
- 2 COLOR-TV CRT SOCKETS Wired leads, for all color TV's ..... **1.00**
- 35-Assorted RADIO KNOBS All standard types \$20 value ..... **1.00**
- 20-TV KNOBS ..... **1.00**
- POPULAR TYPES Mostly Selector & Fine Tuning 25—Clock & Radio KNOBS ..... **1.00**
- most popular types ..... **1.00**
- 20—Vertical Linearity KNOBS Long shank . . . Front mount assortment ..... **1.00**
- 20—Vertical Linearity KNOBS Side mount . . . Standard Sizes ..... **1.00**
- MERCURY COMPACT TUBE TESTER Model #990 Miniature-sized Speca Saver Full sized In performance ..... **49.95**
- TELE-MATIC Tuner-Mate KT-730 Portable "Submini-Tuner" Instant Tuner Check ..... **42.50**
- TELE-MATIC Test Jig Model—EJ-190—Master Rigs—Combo Rigs—Econo Rigs ..... **49.95**

**GE NI-CAD RECHARGEABLE BATTERIES**  
CHARGER & ANY 2 BATTERIES \$12.95  
2-AA BATTERIES ..... \$5.95 Pair  
2-C BATTERIES ..... \$6.25 Pair  
2-D BATTERIES ..... \$6.50 Pair  
1000 Recharges guaranteed

## MARKET SCOOP COLUMN

- ZENITH SILICON STICK RECTIFIER. PART #103-215 — 45KV PIV, also used in Electrohome, Motorola, E.D.I. ..... **5.95**
- CONVERGENCE RECTIFIER—For COLOR TV & Cell Used in RC—Philco—Zenith, etc. ..... **1.00**
- ZENITH VIDEO ..... **2.00**
- AMPLIFIER PART #121-743 ..... **2.00**
- 2-SILICON NPN TRANSISTOR HEP-S0015 . . . List \$1.75 ..... **1.00**
- 1-SILICON NPN TRANSISTOR (SK3534—HEP S5004) ..... **1.00**
- 5-ZENIER DIODE 1N4757A . . . 1 Watt—50 V ..... **1.00**
- 4-ASSTD. PHILCO SWITCHES —PUSH —PUSH TYPE #TV2-3-4, & Sig. Sw. With knobs latest type ..... **2.59**
- POWER TRANSFORMER (PT-48)—110V Pri.—12V Sec. Used in many transistor Power supplies ..... **2.29**
- PANASONIC AC ADAPTER—Model AD-409 4.5, 6, 7.5, 9—Volts—for radio, phonos, tape recorders calculators ..... **2.95**
- COLOR DELAY LINE—Used in most color sets Silicon NPN HV TRANSISTOR RCA—SK-3021—Hep-240 RCA—SK-3026—Hep-241 Transistor Specials—Your Choice SK3008, SK3018, SK3020 SK3122, SK3124 Transistor Specials—Your Choice SK3009, SK3024, SK3040 WAHL-COROLESS SOLDER IRON Complete with Auto Charger—Fast Heating—Compact 5—Audio Output TRANSFORM Sub-min for Trans Radios ..... **1.79**
- 5—I.F. Coil TRANSFORMERS 456-kc for Transistor Radios ..... **1.00**
- 6" UNIVERSAL SPEAKER Top quality Special Buy EA. ..... **1.59**
- 10" UNIVERSAL SPEAKER Large Magnet—Top quality ..... **4.95**
- 8" UNIVERSAL SPEAKER Large Magnet—Special Buy 2 1/2"x4" SPEAKER Special Buy 10 for \$5 EA. 4"x6" "QUAM" 16 OHM SPK. Large magnet . . . Special BUY (10 for \$15.00) ..... **1.79**
- 8" HEAVY DUTY 10 OZ. SPEAKER Ceramic Type—8 ohm 1-6"x9" Heavy Duty 10 oz. Speaker Ceramic Type ..... **5.50**
- 3-ELECTROLYTIC COND. DENERS. 100/80/20 MFD—300 Volts ..... **2.00**
- 6—Top Brand Silicon RECT. 1 amp., 1000 PIV ..... **1.00**
- IC4 and IC3 Integrated Circuit Used in Scott—Fisher etc. ..... **1.00**
- RONETTE Stereo Cartridge latest dual sapphire flipover type Stereo Headphones Hi-Fi Quality Complete with Stereo Plug ..... **2.00**
- 10—STANDARD TRANSISTORS NPN & PNP 2N404, 2N414, etc. 15—Mini 456KC IF Transformers PC 1/2"x1/2"—good value ..... **5.95**
- 7—ASSORTED VOLUME CONTROLS with switch ..... **1.00**
- 10—ASSORTED VOLUME CONTROLS less switch ..... **1.00**
- 15—ASST. ROTARY SWITCHES All popular types—\$20 value ..... **1.00**
- DELUXE PILLow SPEAKERS With plug & volume control ..... **2.49**
- 2-12BH7 RCA TUBES ..... **1.00**
- 10-ASST DIODE CRYSTALS 1N34, 1N48, 1N80, 1N94, etc. TUBE & CONTINUITY CKR. Model FT425 (Tests fuses, heaters, lamds, Etc.) ..... **1.00**
- TUBE SPECIAL—IN LOTS OF 5 2CY5 — 5U8 — 12BD6 — 12BH7 — 18FY6 ..... **2.50**

## SHANNON MYLAR RECORDING TAPE

- 3 1/4" — 600' ..... .78
- 5" — 600' ..... .82
- 5" — 900' ..... .90
- 5" — 1200' ..... 1.49
- 5" — 1800' ..... 1.89
- 7" — 1200' ..... .97
- 7" — 2400' ..... 1.32
- 7" — 3600' ..... 1.99
- CASSETTE C-60 ..... .59
- CASSETTE C-90 ..... 1.19
- CASSETTE C-120 ..... 1.97
- 8-Track — 64 Min. .... 1.29
- 8-Track — 80 Min. .... 1.59
- 8-Track — Cleaner ..... 1.49
- 3" TAPE REEL ..... .09
- 3 1/4" TAPE REEL ..... .12
- 5" TAPE REEL ..... .29
- 7" TAPE REEL ..... .35

## Test Equip. Special Discount Prices

- Leader** SENCORE
- TRANSISTOR RADIO asst type good, bad, broken, as-is, potluck ..... **1.50**
- TAPE RECORDER assorted types good, bad broken, as-is, potluck ..... **4.00**
- 200 ASST. 1/2 W RESISTORS Top Brand, Short Leads, Excellent Selection ..... **1.00**
- 75-ASST 1/4 WATT RESISTORS stand, choice ohmages, some in 5% ..... **1.00**
- 100-ASST 1/2 WATT RESISTORS stand, choice ohmages, some in 5% ..... **1.00**
- 70-ASST 1 WATT RESISTORS stand, choice ohmages, some in 5% ..... **1.00**
- 35-ASST 2 WATT RESISTORS stand, choice ohmages, some in 5% ..... **1.00**
- 50-PRECISION RESISTORS asst. list-price \$50 less 98% ..... **1.00**
- 20-ASSORTED WIREWOUND RESISTORS, 5, 10, 20 watt ..... **1.00**
- 250-ASST SOLDERING LUGS best types and sizes ..... **1.00**
- 250-ASST WOOD SCREWS finest popular selection ..... **1.00**
- 250-ASST Self Tapping SCREWS #8, #8, etc. ..... **1.00**
- 100-ASST 6/32 SCREWS and 100-6/32 HEX NUTS ..... **1.00**
- 100-ASST 8/32 SCREWS and 100-8/32 HEX NUTS ..... **1.00**
- 100-ASST 2/56 SCREWS and 100-2/56 HEX NUTS ..... **1.00**
- 100-ASST 4/40 SCREWS and 100-4/40 HEX NUTS ..... **1.00**
- 100-ASST 5/40 SCREWS and 100-5/40 HEX NUTS ..... **1.00**
- 500-ASSORTED RIVETS most useful selected sizes ..... **1.00**
- 100-ASST RUBBER BUMPERS for cabinet bottoms—other uses ..... **1.00**
- 100-ASST RUBBER GROMMETS best sizes ..... **1.00**
- 1-KENWOOD TWEETER Special Buy—4" Round ..... **4.79**
- 10-ASST SLIDE SWITCHES SPST, SPDT, DPDT, etc. For Transistors ..... **1.00**
- 25-SYLVANIA HEAT SINKS For Transistors ..... **1.00**
- 20-ASSORTED TV COILS I.F. VIDEO, sound radio, etc. ..... **1.00**
- 1-ELECTROLYTIC COND. 200/300/100/100 MFD—25V ..... **1.00**
- 1-ELECTROLYTIC COND 100 MFD—300V ..... **1.00**
- 3-ELECTROLYTIC COND 20/20 MFD—450V ..... **1.00**
- 40-ASST. TUBE CARTONS Most popular types ..... **1.00**
- 2-ELECTROLYTIC Condensers 300 mfd-200V, 300/60 mfd-150V ..... **1.00**
- 4-ELECTROLYTIC COND 75/30mfd—150V ..... **1.00**
- ELECTROLYTIC CONDENSERS 200/200 mfd.—200V ..... **1.00**
- 2-ELECTROLYTIC COND 1000 mfd.—25V ..... **1.00**
- 50-ASST. CERAMIC CONDENSERS—Most desirable values 2 COLOR-TV CRT SOCKETS Wired leads, for all color TV's ..... **1.00**
- 3-RCA 110° CRT SOCKETS Wired leads, for all TV's ..... **1.00**
- 4-36" Hi-Fi CABLES RCA Molded Phone plug at one end stripped and tinned leads on other end ..... **1.00**
- 3-Polarized CHEATER CORD Grey ..... **1.00**
- 70° COLOR TUBE BRIGHTNER ..... **3.95**
- 90° COLOR TUBE BRIGHTNER ..... **4.95**
- 5-PNP TRANSISTOR general purpose, TO-5 case ..... **1.00**
- 5-NPN TRANSISTORS general purpose, TO-5 case ..... **1.00**
- 25-ASSORTED TRANSISTORS big factory scoop—sold as-is ..... **1.00**
- 5-9 VOLT MOTORS Excellent for hobbyist ..... **1.00**
- 2-ELECTROLYTIC CONDENSERS Axial leads—500—25V TACHOMETER 2 1/4" Sq. Panel Meter 1-VDC, full scale 33 Ohm coil resistance 0-6000 R.P.M. 1-CASSETTE type dynamic Mike with universal plugs—200 Ohms ..... **2.99**
- 10-SETS PHONO PLUGS & PIN JACKS RCA type ..... **1.00**
- 3" X 5" SPEAKERS TV replacement . . . Special buy ..... **1.29**
- ZENITH TRIPLER PART #212-109 Equivalent to ECG501—38KV Out., 2500pf. ..... **3.95**

## KLEPS "CLEVER" TEST PRODS

- "Third-hand" test prods, reach into out of way places - Insulated - cannot slip - accommodates bare wire or banana plug—no soldering. .... **89¢**
- PRUF 10—Versatile Test Probe ..... **1.39**
- KLEPS 10—Boothook Clamp 4 1/4" long ..... **1.49**
- KLEPS 20—Boothook Clamp 7" long ..... **1.79**
- KLEPS 30—flexible-forked Tongue 6" long ..... **2.59**
- KLEPS 40 FLEXIBLE-PC Board Terminals 6 1/4" long ..... **99¢**
- KLEPS 1-ECONOMY Kleps for Light Work
- KANDU—Printed Circuit Kit Trace & Etch your own circuits easy to use Instructions ..... **9.95**
- MONAURAL PICKUP ARM & CARTRIDGE**
- Direct replacement for most phono pickups ..... **2.95**
- Also direct replacement for transistorized portables ..... **2.95**
- HIGH VOLTAGE POWER TRANSISTOR Equip. HEP 707 . . . List price \$18.00 ..... **2.29**
- 1 —VARCO STEREO CARTRIDGE Model TN4B with holder ..... **2.95**
- 2-ELECTROLYTIC CONDENSERS 80/100/60 MFD—160V ..... **1.00**
- 2-ELECTROLYTIC COND 200/30/4—mfd—350V ..... **1.00**
- 3-ELECTROLYTIC COND 100 mfd—100V, 50 mfd—75V ..... **1.00**
- 2-ELECTROLYTIC COND 40 mfd—500V, 40 mfd—400V ..... **1.00**
- 8-MINI PILOT BULBS With 8" Leads—6.3V 30MA (5000 Hrs) ..... **1.00**
- 8-MINI PILOT BULBS With 12" Leads—6.3V, 150MA (5000 Hrs.) ..... **1.00**
- 32—TEST PROD WIRE DELUXE QUALITY red & black 1-COLOR POWER TRANSFORMER RCA 2BR150 special ..... **6.95**
- 2-Color Quartz Crystal For most color TV sets 3579.545 KC 5 ASST GLOBAL VARISTOR Popular replacements for most COLOR TV COLOR-TV RECTIFIER—Used in most color sets—6500 kv 3 for. .... **1.95**
- 4 —TV ALIGNMENT TOOLS most useful assortment #1 ..... **1.00**
- 4 —TV ALIGNMENT TOOLS most useful assortment #1 ..... **1.49**
- For Color TV #2 ..... **2.79**
- 6 —TV ALIGNMENT TOOLS Most popular type TV TWIN LEAD-IN 300 ohm 500'—\$7.00—\$15.50, 50' CO-AX CABLE RG59U (Black) 250'—\$10. 100'—\$4.50, 50' 5-DUAL DIODE—MOST POPULAR TYPES Common cathode or Series connected ..... **2.50**
- 15-DIPPED MYLAR CAP. .01—600V ..... **1.00**
- 15-DIPPED MYLAR CAP. .033—600V ..... **1.00**
- 15-DIPPED MYLAR CAP. .0033—1000V ..... **1.00**
- 15-DIPPED MYLAR CAP. .047—400V ..... **1.00**
- 15-DIPPED MYLAR Condensers .056—400V .0039 400V ..... **1.00**
- 6—TRANSISTOR RADIO EARPIECES wires complete with plug 7-TV ELECTROLYTIC CONDENSERS desirable types 25-0033 DISC CERAMIC CAPACITORS C.R.L. 50-ASST. TERMINAL STRIPS all types, 1-lug to 6-lug ..... **1.00**
- UNIVERSAL 4" PM SPEAKER Top Quality ZENER DIODE MOTOROLA HEP 105 1 Watt—6.2 Volts CAR POWER ADAPTOR 12 Volt hi—6V, 7.5V 9 Volt Out—300MA 50-ASST. TUBULAR COND. DENERS Popular values 25' Shielded MIKE CABLE Grey 25/1 ..... **1.00**
- 50-ASSORTED FUSES Popular asst. ampere ratings 35—RADIO & TV SOCKETS all type 7 pin 5 pin etc. (10-20-40 OHM Imped.) 4-50' HANKS Hook-Up Wire assorted colors VU "T" PANEL METER 0-20 dB Scale ..... **1.29**
- 10-ASST RADIO & TV TUBES Every Tube a good number UHF or VHF Matching Trans. Simple Foot-proof Installation TV AMPER DIODE Single-Replace RCA part #120818 Dual—RCA part #135932 12" UNIVERSAL SPEAKER Top Quality . . . Large Magnet ..... **7.95**

IMMEDIATE DELIVERY . . . Scientific light packing for safe delivery at minimum cost.  
HANDY WAY TO ORDER . . . Send check or money order, add extra for shipping. Lists of new offers will be returned by your order.  
Please specify refund on shipping overpayment desired:  CHECK  PDSTAGE STAMPS  MERCHANDISE (our choice) with advantage to customer

**BROOKS RADIO & TV CORP., 529 Columbus Ave., New York, N.Y. 10024** TELEPHONE 212-874 5600

CIRCLE 36 ON FREE INFORMATION CARD

OCTOBER 1976

**NEWS RELEASE 1976**

**OFFICIAL TESTING LAB RATES ALLISON #1... the BEST of ALL Ignition Systems!**

The ALLISON "Opto" was Officially Rated #1 by a Foreign Government Testing Laboratory as the BEST "Fuel Saving" Ignition of ALL the Ignition Systems Tested, including Systems with C.D. "add-ons"!

**NEW ALLISON 'OPTO XR-700'**

with the Exclusive... "Built-In" SOLID-STATE VOLTAGE REGULATOR

The "XR-700" is a NEW, redesigned, EASIER TO INSTALL version of the Allison "Opto-Electric", with the New addition of the Voltage Regulator, making it the MOST RELIABLE and Fool-Proof Ignition System ever invented.

Allison replaced the mechanical Breaker-Points and Condenser with a "Highly Accurate" Optical Control. A Beam of Light, passing through a specially designed "ROTOR" precisely triggers a Heavy-Duty "POWER MODULE" that BOTH "Charges and Fires" the Ignition Coil, with the "FASTEST" High Voltage RISE TIME, producing the MAXIMUM "HIGHEST ENERGY" SPARK available.

Since there is NO Mechanical Friction, there are NO Parts to ever WEAR or need replacing, and ONCE properly Timed, it should NEVER need any Maintenance! DWELL never needs adjustment, it is PRE-SET to supply the OPTIMUM Performance at BOTH High and Low Speeds. The RPM Capability of the "XR-700" is Factory Tested to 15,000 RPM.

The "High-Energy" SPARK INTENSITY and DURATION... permits the Positive FIRING of Spark-Plugs, even under the MOST ADVERSE conditions, results in more COMPLETE COMBUSTION and Eliminates "Engine Misfire", hence fewer exhaust Emissions, IMPROVED Fuel Mileage, a HIGHER Performance Level... and helps keep Plugs FROM FOULING, which greatly extends the Spark-Plug LIFE!

Only the Highest Grade (U.S. Made) Solid-State Components are used... UNAFFECTED by Moisture or Vibration! The Allison "XR-700" was engineered to OUTLAST the LIFE OF YOUR CAR!

"EASY-TO-FOLLOW" INSTALLATION. (Not Necessary to Dismantle your Distributor.)

"CB" USERS: The XR-700 completely ELIMINATES the Major Cause of Primary (Ignition Noise) Interference.

America's Oldest and Largest Manufacturer of Opto-Electronic Ignition Systems.

**ALLISON** \* Our BEST Salesmen... are the USERS of our ALLISON Systems!  
AUTOMOTIVE CO. 1267 -E9, East EDNA Pl., COVINA, CAL. 91722

CIRCLE 44 ON FREE INFORMATION CARD

**DIGICOLOR ORGAN**  
continued from page 68

is wrong. Using point M as a reference, the voltage at point S should be about 9 and at the Q1 side of C3 should be about 5. These voltages indicate proper power supply operation. In any case, unplug the unit and check all component placement, component orientation and solder joints.

The light display built for the prototype uses a hexagonal lensed translucent plastic panel that is used to cover fluorescent lights. The plastic panel is mounted on the front of a black vinyl covered 23 1/2 x 13 1/4 x 14-inch particle board box. The low-wattage lights connected to the color organ are several inches behind the plastic panel on the inside of the box, and the color organ circuit board itself is attached to one of the sides on the inside of the box. A small rectangular hole is also provided on the side of the box so a panel holding power switch S2 and potentiometer R8 can be mounted. When viewed from the front, each of the lights that are turned on behind the panel have the appearance of a six-petal flower whose size and brightness are dependent upon the light wattage and the light's distance from the plastic sheet.

Although this type of display was used on the prototype, almost any type of display or light configuration can be used as long as it uses 117-volt lights and not more than 800 watts per channel.

The unit should be wired as shown in the wiring diagram, Fig. 4. Although high-wattage spot or flood lights may be used, it is recommended that parallel combinations of smaller lights (40 watts or less) be used instead, since the smaller lights have a faster response time. Fuse F1 and switch S2 must be capable of handling the total amount of current drawn by the lights. Since the lights require much more than their rated power for a short period of time after turn-on it is best to use a slow-blow fuse. Its rated current should be about 1 ampere for every 100 watts of bulbs connected to the unit. If the total combination is greater than 1,000 watts, use a heavy line cord. All the wiring interconnecting the lights and points W, Z, E, A, B, C and D must use at least No. 18 gauge wire and go to a heavier gauge if more than 500 watts of bulbs are connected to the unit.

After the organ has been wired as shown in Fig. 4, all points on the circuit board—excluding the secondary side of transformer T2—are either directly or indirectly connected to one side of the line cord. So be sure not to attempt repairs or measurements on the unit while it is plugged in.

Connect the input terminals of the color organ to the speaker terminals of your existing sound system as shown in the wiring diagram. Turn both your sound system and color organ on and set the repetition rate control R8 to give the most desired visual effect.

The unit can detect low-level noise generated by your amplifier, so the display may be active while there is no sound from the speakers. When the normally audible sound level coming from the speakers is present, the low-level noise is superimposed on this high-level signal and will not affect the unit's operation.

If the organ is driven from sound sources delivering more than 100 watts, increase the value of R1 and R2 to 500-ohm, 5-watt resistors.

R-E

**FREE catalog**  
over 2000



unique tools, handy kits, precision instruments, technical supplies.

Over 24 years of service to the world's finest craftsmen and technicians.

A carefully selected and tested assortment of unique, hard-to-find tools, clever gadgets, precision instruments, bargain kits. One-stop shopping for the technician, craftsman, hobbyist, lab specialist, production supervisor. Many tools and measuring instruments available nowhere else. One of the most unusual and complete tool catalogs anywhere. Get your copy of the NC FLASHER today.

**National Camera**  
2000 West Union Ave., Dept. GBA  
Englewood, Colorado 80110  
(303) 789-1893

CIRCLE 15 ON FREE INFORMATION CARD

**FREE burglar — fire alarm catalog**



over 900 systems, detectors, controls, sounders, tools, locks, supplies

**TO PROTECT HOMES, BUSINESSES, INDUSTRY**

Huge selection of hard-to-find security equipment from stock. 64 fact-filled pages loaded with 100's of highest quality professional alarm products, technical notes, diagrams.

**ONE-STOP SUPERMARKET SELECTION INCLUDES:**

ultrasonics, radar, infrared, undercarpet mats, magnetic contacts, smoke & heat detectors; Controls; Alarms: bells, sirens, phone dialers, lights, guard panels. Large selection of tools, relays, wire, holdup alarms, books. Fills need for industry, alarm cos., businesses, homes, institutions. Order your copy today. (Outside U.S., send \$1.00.)



mountain west alarm  
4215 n. 16th st.  
phoenix, az. 85016  
(602) 263-8831

CIRCLE 14 ON FREE INFORMATION CARD

## 40-CHANNEL CB

continued from page 6

may not be very much new 40-channel CB equipment available before March 1977. And even then, shortages and scarcity of equipment for sale should be commonplace.

Although a reduction in the age requirement for an operator was proposed, 16 instead of the current 18-years, it was not approved. The minimum age for a license is still 18. However, under the present rules, all persons under the age of 18 residing in the same household may operate under a license held by a parent.

The proposal to combine Class-C and Class-D operating privileges under one license was not adopted. The subject is still under review but no change will be made now.

The Citizens Radio Service name will not be changed. The FCC believes that the proposed names are more descriptive of the character of the service. However, since such changes would obsolete millions of application forms, license documents and other printed material, the change of name will not be implemented now, but will be made at a more opportune future date.

Perhaps most important of all is the FCC statement that the channel expansion to 40-channels is only an interim measure. The problem of long distance "skip" propagation at 27-MHz caused by sunspot activity is minimal at this time. In the next several years the solar cycle is expected to peak and much long-distance interference is expected. As a result, the FCC Office of Plans and Policy and the Personal Use Radio Advisory Committee (PURAC) is studying the area of personal radio. Both groups will consider an alternate spectrum in the 220- and 900-MHz range that favor radio wave propagation over short line-of-sight distances and is unaffected by the solar cycles. This could mean a change at some future date to a completely different set of frequencies and all existing CB gear for 27-MHz operation would be obsolete. It would also mean that the new gear would be much more costly, because of the frequencies involved. **R-E**

## "Swan Lake" broadcast-telecast is largest in stereo history

The *Live from Lincoln Center* broadcast-telecast of the American Ballet Theatre's "Swan Lake" last June 30 was the largest live stereo network transmission in the history of broadcasting. The broadcast covered a potential audience of 107 million—more than half the nation's television viewing audience.

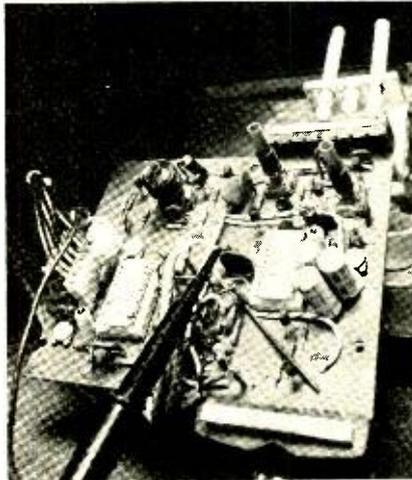
The television portion of the program was transmitted over PBS TV stations, and the stereo network signals of the sound portion were distributed by land line, microwave and satellite. Viewers were urged to tune their TV sets to the local PBS TV station and their FM radios to the local station carrying the Lincoln Center stereo broadcast—placing a speaker on either side of the TV set, if practicable.

The *Live from Lincoln Center* broadcast was produced by Lincoln Center in col-

laboration with WNET/Channel 13. The ballet featured Natalia Makarova as the Swan Queen and Ivan Nagy as Prince Siegfried. **R-E**

## Paper on quadriphonic FM receives Chicago IEEE honors

A paper entitled *A Quadriphonic FM Broadcasting System Incorporating Pilot-Control Compression and Pre-Emphasis* was selected as the outstanding paper presented at the 1975 Fall Conference of



**DISCRETE FOUR-CHANNEL FM SYSTEM, shown undergoing tests in the Zenith engineering studio, is part of the company's quadriphonic broadcasting system proposed for adoption by the Federal Communications Commission.**

the Chicago Section of the IEEE and the Consumer Electronics Group (CEG). Authors were Pieter Focken and Carl G. Eilers, Zenith research scientists.

The system reported on is the one now being proposed by Zenith Radio Corp. for adoption by the FCC as the standard for quadriphonic broadcasting. **R-E**

## FCC and discount phone service

An FCC draft order now under consideration would, if put into effect, strike down the phone company's prohibition against resale and sharing of private-line services. This would permit greater access by small users to Bell's Telpak service, through which users get "bundles" of 60 or 240 lines at low rates.

The draft proposal asserts that the resale and sharing proposal would eliminate waste that occurs because the bulk rate structure often encourages customers to buy much more capacity than they can use.

The FCC pointed out that there are already significant exceptions to the phone company's rule against sharing or reselling private-line service. Western Union, for example, leases several types of facilities for resale to others. Aeronautical Radio, Inc., a not-for-profit organization owned by the nation's domestic airlines, is treated as a "single customer" allowing a number of companies access to the service.

The FCC draft order states: "What our decision does is simply to require that AT&T treat all its customers alike unless valid reasons exist to the contrary." **R-E**



# LIFE OR DEATH SITUATION

Not all 2-way radios warn about Smokies taking pictures.

Professional FM two-way radios—the most important ones—are for bringing help fast in life or death emergencies. And if you've had some serious electronics experience you just might fit into this important, expanding field.

MTI is the only home study school that deals exclusively with service and repair of professional two-way radios.

Think you're good enough to become part of it all? Drop us a line to find out.

Please send me more information.

Name

Address

Code

- I am a former MTI student.  
 I am presently in the military.  
 I am a veteran. **x3**



Formerly

**MOTOROLA TRAINING INSTITUTE**

College Hill Road  
Summerdale, PA 17093  
(717) 732-3636

OCTOBER 1976



## Brighten her day as you brighten yours with a four-pack of Perma Power Color-Brite

PRODUCTS OF  Chamberlain

Save money now on  
a four-pack of  
Perma Power C-511  
Color-Brite... and get  
a beautiful necklace  
for her as a FREE BONUS!

With their colorful beads and liquid silver style chain, nothing will brighten her day like these beautiful necklaces. We've selected a variety of bead styles, so you can get a pattern for each of your girls. You'll brighten your day as you save more than \$1.00 per brightener on the brightener you use most often. You'll brighten your customer's day, too, because Model C-511 Color-Brite immediately restores sharpness, detail and contrast to faded color picture tubes. And they fit most sets.

Offer valid only while supply lasts. Hurry to your distributor today!



### Perma Power

Chamberlain Manufacturing Corporation  
Perma Power Division  
845 Larch Avenue, Elmhurst, Illinois 60126  
Telephone (312) 279-3600

CIRCLE 38 ON FREE INFORMATION CARD

## CB FREQUENCY SYNTHESIZERS

*continued from page 44*

the desired channel.

On Channel 19, the 23.490- and 14.970-MHz oscillator signals are summed in the synthesizer mixer to produce a 38.460-MHz output. When transmitting, this signal beats with the signal from the 11.275-MHz oscillator to provide the desired 27.185-MHz Channel-19 output frequency.

When the transceiver is in the receive mode, the synthesizer output and the incoming signal beat in the first mixer to develop the 11.275-MHz first IF (38.460 - 27.185 = 11.275). This signal is heterodyned against the output of the 11.730-MHz crystal oscillator to develop the 455-kHz second IF. Fixed capacitors can be switched in and out of the crystal circuit to provide +1 kHz and -1 kHz delta tuning.

If you want to be sure that you understand this variation on the frequency synthesizer, try a few examples on your own. Just remember that the transmitter frequency equals the *sum* of the crystal frequencies selected by S1-a and S1-b *minus* 11.275 MHz. The first local oscillator in the receiver equals the *sum* of the two selected crystal frequencies and is 11.275 MHz *above* the channel frequency.

There are a few other variations in the heterodyne-type frequency synthesizer but you won't find them difficult to understand if you master the three schemes covered here. Frequency synthesizers are almost as easy to troubleshoot as circuits using individual crystals in the receiver and transmitter circuits for each channel. As an exercise, see if you can prepare a chart that will indicate which crystal circuits are defective if: you can transmit but cannot receive on any one channel or on any group of channels; receive but cannot transmit on one or more channels; or you can receive but cannot transmit on any channels. While this is keeping you busy—and, I hope, entertained, I'll be pouring over PLL circuits that I hope to include in an early issue. **R-E**



## A Completely Portable, Polytonic Synthesizer System For Under \$140.00

CONJURE IT UP FROM:

THE GNOME MICRO-SYNTHESIZER kit  
no. 3740 \$48.95 + 4 lbs. shipping

— AND —

OZ-MINI-ORGAN & POLYTONIC PITCH SOURCE  
kit no. 3760 \$84.95 + 12 lbs. shipping

Hear them on our 24 hr. Demo-Line (405) 843-7396  
and get our FREE CATALOG with more

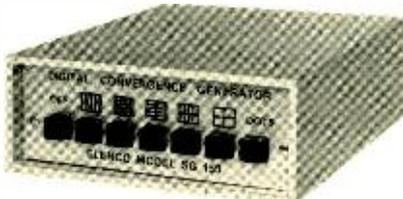
## Magical Musical kits

FROM: **RAIA** ELECTRONICS DEPT. 10 - R  
1020 WEST WILSHIRE BLVD.  
OKLAHOMA CITY, OK 73116

CIRCLE 74 ON FREE INFORMATION CARD

## DELUXE DIGITAL COLOR CONVERGENCE GENERATOR

10 ROCK SOLID PATTERNS  
ALL IC COUNTDOWN CIRCUITS  
QUARTZ CRYSTAL OSCILLATORS  
2 FULL YEARS' WARRANTY



MODEL SG-150 \$75<sup>95</sup>



MODEL  
SG-100

ONLY  
\$59<sup>95</sup>

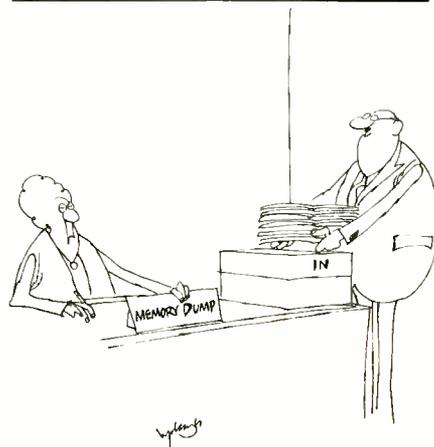
2 Patterns: 20 x 16 Crosshatch, 320  
Dots, weight only 17 oz.

WRITE OR CALL FOR DETAILS

**ELENCO ELECTRONICS INC.**

1928 Raymond Dr., Northbrook, IL 60062  
(312) 564-0919

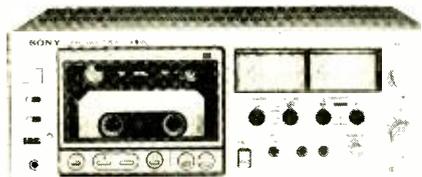
CIRCLE 7 ON FREE INFORMATION CARD



**"ELCASET"**

(continued from page 50)

lengths; 30 minutes and 45 minutes per-side, respectively) are just becoming available. Obviously, audiophiles are not going to rush right out to their nearest tape dealers to purchase them by the dozens unless there are machines to go with them. At the recent Consumer Electronic Show held in Chicago, we saw two such machines that were ready for the marketplace, both produced by Sony (one of the Elcaset's sponsors). The model EL-5 shown in Fig. 8 is expected to sell for around \$630.00,

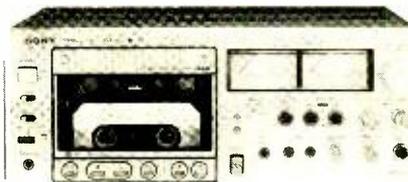


**FIG. 8—SONY MODEL EL-5 STEREO DECK uses the new Elcaset.**

while the model EL-7 (shown in Fig. 9) will have a nationally advertised value of around \$900.00. Neither of these machines takes full advantage of all the automatic possibilities inherent in the Elcaset's construction, but both machines were able to produce recordings that, upon first hearing, certainly sounded excellent in terms of fidelity

and signal-to-noise ratios.

At that same trade show, we saw prototypes of Elcaset decks developed by the other two sponsoring companies. Technics by Panasonic and Teac, both of which went far beyond the features available in Sony's first production models. They also will probably be far beyond the price of the EL-5 and EL-7 as well, though no prices or delivery



**FIG. 9—SONY MODEL EL-7 ELCASET STEREO DECK.**

dates were quoted by representatives of either company.

Besides the three previously mentioned companies, two other manufacturers, Aiwa and JVC have also agreed to adopt the Elcaset system standards. These companies, and perhaps others, will no doubt announce products and place them on the market in the near future.

There will no doubt be Elcaset machines available in the future that will sell for less than the first available units already seen. But if scaled down versions do appear, the question natu-

rally arises as to whether these less expensive Elcaset machines (that will probably not take advantage of the increased control flexibility and detection systems built into the basic Elcaset) will really offer any advantages over similarly priced well-performing standard cassette decks.

There is also the question: Where will they fit in? The enthusiastic promoters of the Elcaset feel certain that the Elcaset will bring new recordists into the marketplace; people who wanted something better than the best cassette decks offer, for one reason or another, but did not want to get involved with the added complexity of open-reel tape recording. Claims of "equal performance" to open-reel machines can be contradicted to some degree. While the Elcaset will permit editing more easily than does a standard cassette, precision editing will not be as easy as it is with open-reel machines, which means that the very serious, semi-professional recordist may shy away from the new format, if only for that reason. Then too, if 3/4-IPS tape travel provides better performance than is possible with 1 7/8-IPS speeds (and there is no doubt about that), then it can be argued that open-reel machines still have the upper edge in absolute fidelity at their 7 1/2 and even 15 IPS speeds. On the other hand, no one would have predicted that the standard

**A PRIME STANDARD AT YOUR FINGERTIPS**

**\$348**

**FOR COMPLETE MEASURING CONFIDENCE**

**A NEW STANDARD IS BORN**  
High accuracy you can trust . . . .  
Versatile measuring capabilities . . . .  
An efficient, easy to operate meter . . . .  
All at an affordable price . . . .  
That's the DVM38 . . . . The complete DVM that sets new performance standards in 4 key areas.

**A NEW ACCURACY STANDARD**  
The 3 1/2 digit, .1% accuracy is backed by a 15 meg Ω input impedance, compared to 10 meg Ω input of conventional DVM's, which guarantees up to 50% greater accuracy with 1/3 less circuit loading on every measurement for high accuracy you can trust.

**A STANDARD IN CAPABILITIES**  
The DVM38 is more accurate in MORE circuits with these versatile ranges: 100 μV to 2000V DC, 1KV AC; .01 Ω to 20 meg Ω; 0.1 μA to 2A . . . . Plus

HI and LO ohms and a 50KVDC range with accessory Hv probe.

**A NEW STANDARD IN SPEED AND EASE OF OPERATION**  
Large pushbuttons and callouts — no need to hunt and peck. Large .4" L.E.D.'s with direct readout, down to V and mV indicators. SINGLE STEP AUTO-RANGING for maximum resolution and efficiency. 2KV DC protection minimizes downtime.

**THE AFFORDABLE STANDARD**  
There are few .1% DVM's less expensive—there are none as complete in this price range, plus backed by a LIFETIME guarantee against factory workmanship errors.

**THE DVM38 . . . . . A NEW STANDARD IN DVM's FOR SPEED, VERSATILITY AND ACCURACY.**

**DVM38** BACKED BY SENCORE'S 100% MADE RIGHT LIFETIME GUARANTEE

**SENCORE** 3200 Sencore Drive, Sioux Falls, S.D. 57107  
Phone 1 605 338 0100 T.W.X. 910 660 0300

CIRCLE 75 ON FREE INFORMATION CARD

**Clever Kleps**

Test probes designed by your needs — Push to seize, push to release (all Kleps spring loaded).

- Kleps 10.** Boathook clamp grips wires, lugs, terminals. Accepts banana plug or bare wire lead. 4 3/4" long. **\$1.39**
- Kleps 20.** Same, but 7" long. **\$1.49**
- Kleps 30.** Completely flexible. Forked-tongue gripper. Accepts banana plug or bare lead. 6" long. **\$1.79**
- Kleps 40.** Completely flexible. 3-segment automatic collet firmly grips wire ends, PC-board terminals, connector pins. Accepts banana plug or plain wire. 6 1/4" long. **\$2.59**
- Kleps 1.** Economy Kleps for light line work (not lab quality). Meshing claws. 4 1/2" long. **\$ .99**
- Prof 10.** Versatile test prod. Solder connection. Molded phenolic. Doubles as scribing tool. "Bunch" pin fits banana jack. Phone tip. 5 1/2" long. **\$ .89**

All in red or black - specify. (Add 50¢ postage and handling). Write for complete catalog of - test probes, plugs, sockets, connectors, earphones, headsets, miniature components.

Available through your local distributor, or write to:

**RYE INDUSTRIES INC.**  
126 Spencer Place, Mamaroneck, N.Y. 10543  
In Canada: Rye Industries (Canada) Ltd.

CIRCLE 29 ON FREE INFORMATION CARD

performance that it now does, and in like manner, the Elcaset and its hardware are bound to undergo refinements and further improvements as this new tape format begins to gain acceptance and the public begins to make its needs known.

Obviously, it is too early to come to any definite conclusions regarding the future of the new Elcaset. We have yet to test our first one (but you can be sure that we will, and will report the results in these pages as soon as we can get our hands on a sample machine).

In the meanwhile, you might find it worthwhile to compare the characteristics of cassettes, Elcaset and open reel using the information supplied by one of its sponsors and tabulated in Table I. Bear in mind, though, that this information, while completely true, may not take *all* factors into consideration since, as we stated, it is compiled by a very interested party. **R-E**

### CB AND SWR

*continued from page 84*

you can't quite get a grasp on, you're right.

When you think you've got one effect beat another takes its place. For example, most of you are familiar with the

"trick" of reducing the SWR reading by "trimming" the transmission line. The only thing you are actually trimming is your antenna's radiation pattern.

A mismatch causes current to flow on the transmission line shield and the line actually becomes part of the antenna (parallel currents). The line radiates and modifies the antenna's radiation pattern. When you trim the line you are actually trimming the radiating antenna system, and who knows what's happening to your signal. As far as the SWR meter is concerned, everything after the meter's output terminals is antenna, not transmission line. If trimming the transmission line reduces the SWR reading, you know for certain you've got problems that are being caused by the antenna.

And antenna problems is all the SWR meter really shows the CB'er; that's why it's so important. Unless the SWR is 2:1 or less for a station fed with less than 100-feet of RG-8/U, or less than 1.5:1 for 100-feet or more of RG-8/U or RG-58A/U, you know for certain much of your transmitter's output isn't getting into the antenna. The best antenna in the world won't help if you don't put RF into it.

In fact, the ideal Citizen-band installation should consist of at *least* a transceiver, an antenna and an standing-wave ratio meter. **R-E**

### STEP-BY-STEP

*continued from page 97*

If you lose the 3.58-MHz signal at any point in this series, stop and check out the place where it's disappearing. The standard causes will be found—open coupling capacitors, bad resistors, open PC board conductors, open coils, bad solder-joints and so on.

If the signal output of the oscillator is too low, it can cause a weak-color symptom. Check back to make sure that the input signal and others are up to normal amplitude. If they are, start looking for things like a weak subcarrier amplifier tube, low DC voltages on this tube, low screen-grid voltage, defective cathode resistor or open cathode bypass capacitor.

If all colors are off and can't be brought back by realignment, check the varactor diode, its DC voltages, and substitute a new crystal. One quick check here is to turn the tint control and see if it does *anything*. If it does not, check the small coaxial cable connecting the tint control to the chassis: loose ground, short or open in the coax.

If everything seems normal in this circuit and the tint control does have some effect, it might be a good idea to run a quick check on the demodulator *balance* adjustments. These may have been turned to the wrong setting by someone who didn't know what was going on. In this type of demodulator, it's fairly easy. Just read the DC voltage on each of the test-points, which means the grids of the three color-difference amplifier tubes. This should be zero with a color-bar signal input. If any of them are off, readjust the DC balance control to zero. This should be the last step in the color alignment.

All in all, this isn't a hard circuit to service if you know how it works and what the *normal* reactions and tests are. Just go through it one logical step at a time and you will find the defective part very quickly. Remember the one we mentioned a while back: if that neon tube isn't glowing, fix that first or you're not going to get *anywhere!* **R-E**

### PICTURE PULLS IN

*This Zenith 20CC50Z is getting to me! The vertical size and linearity controls have very little effect and the picture is stretched a little but only in the lower half! Also, the corners of the raster pull in at the bottom of the screen. This is worse with low brightness. Wow!—E.M., Kew Gardens, NY.*

Check the 30- $\mu$ F electrolytic capacitor connected in the screen grid circuit of the 6JB5 vertical output tube. This is *not* the screen-grid bypass capacitor; that is the 10- $\mu$ F connected directly to the screen terminal with its negative going to the cathode. There is a 22K resistor between the 30- $\mu$ F and the screen. This is actually a waveshaping capacitor that works in the pincushion-correction circuitry! If it's open, you can get a fake keystone raster.

Don't overlook the little 100- $\mu$ F electrolytic in the 6JB5 *cathode* circuit, either. This can cause some real oddball problems.

For  
faster  
service

USE  
ZIP  
CODE

on  
all  
mail

## Accuracy like a VTVM... Convenience like a VOM...

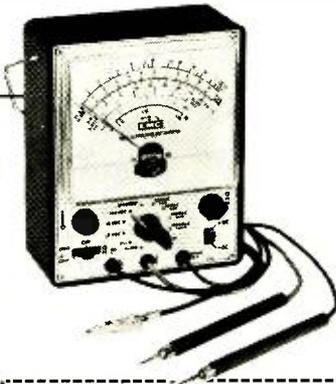
### NEW BATTERY-OPERATED FET SOLID-STATE VOLT-OHMMETER #116

Easy-to-build KIT

**\$39.48** =116K

Factory-Wired & Tested

**\$52.95** =116W



Now you can get all the benefits of a VTVM (laboratory accuracy, stability and wide range) but with its drawbacks gone: no plugging into an AC outlet, no waiting for warm-up, no bulkiness. New Field Effect Transistor (FET) design makes possible low loading, instant-on battery-operation and small size. Excellent for both bench and field work.

#### Compare these valuable features:

- High impedance low loading: 11 meg-ohms input on DC, 1 megohm on AC
- 500-times more sensitive than a standard 20,000 ohms-per-volt VOM
- Wide-range versatility: 4 P-P AC voltage ranges: 0-3.3, 33, 330, 1200V; 4 RMS AC voltage ranges: 0-1.2, 12, 120, 1200V; 4 DC voltage ranges: 0-1.2, 12, 120, 1200V; 4 Resistance ranges: 0-1K, 0-100K, 0-10 meg., 0-1000 meg.; 4DB ranges: -24 to +56DB.

Sensitive easy-to-read 4 1/2" 200 micro-amp meter. Zero center position available. Comprises FET transistor, 4 silicon transistors, 2 diodes. Meter and transistors protected against burnout. Etched panel for durability. High-impact bakelite case with handle useable as instrument stand. Kit has simplified step-by-step assembly instructions. Both kit and factory-wired versions shipped complete with batteries and test leads. 5 3/4" H x 6 3/4" W x 2 7/8" D. 3 lbs.

Send FREE catalog of complete EMC line and name of nearest distributor. RE-10

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_  
State \_\_\_\_\_ Zip \_\_\_\_\_

**EMC**

ELECTRONIC MEASUREMENTS CORP.  
625 Broadway, New York, N.Y. 10012

# next month

NOVEMBER 1976

## ■ Build A Phone Dialer

Convert a calculator to double as an automatic phone dialer. It isn't difficult and the device is really handy.

## ■ CB Accessories

Unusual devices that you'll want to add to your CB rig.

## ■ Creating Sine Waves Digitally

Don Lancaster shows how to synthesize sinewaves with digital techniques.

## ■ Build A Digital Clock

Gas discharge display with automatic intensity control, AM-PM indicator, alarm; circuit-board construction.

## ■ Digital Test Equipment

Specifications, analog-to-digital conversion techniques, applications and more.

## PLUS

Step-By-Step Troubleshooting

Komputer Korner

VIR For Better Color TV Pictures

Two Hi-Fi Lab Test Reports

Jack Darr's Service Clinic

# FCC LICENSE STUDY GUIDE

If you have experience or training in electronics, but need specific help in preparing for FCC license exams, perhaps you need *Grantham's FCC License Study Guide* — not a Q&A book, not a correspondence course, but simply an authoritative, down-to-earth presentation of what you should know to pass your FCC exams for 3rd, 2nd, and 1st class radiotelephone licenses. Included are four information sections, and 1465 FCC-type multiple-choice questions with more than 65,000 words "explaining" the correct answers. The book is 7 x 10½, with 377 pages. Self-study presentation. Now, only \$9.95 *postpaid*. Order from:

**GSE Publishing Company**  
2000 Stoner Ave., Los Angeles, CA 90025

## GRANTHAM OFFERS YOU College-Level Training and a college degree.

Electronic circuit design, engineering analysis (including math through calculus), classical and solid-state physics, computer science, etc., etc., are all part of the Grantham home-study electronics degree program.

### PUT PROFESSIONAL RECOGNITION IN YOUR CAREER.

By adding college-level home training and a college degree to your experience, you can *move up* to greater opportunities in electronics.

Grantham offers the A.S.E.T. degree by correspondence. After earning this degree, you may continue with additional correspondence plus a 3-day residential seminar and certain transfer credits, to earn the B.S.E.E. degree. Our *free* bulletin gives complete details of the program itself, the degrees awarded, the requirements for each degree, and how to enroll. Write, or phone (no collect calls please), for our free BULLETIN R-76.

### GRANTHAM SCHOOL OF ENGINEERING

2000 Stoner Ave., Los Angeles CA 90025

● Telephone (213) 477-1901 ●

Worldwide Career Training thru Home Study





# endeco soldering & desoldering equipment

## SOLDERING IRONS

Pencil style. Safety light. Two heats — 20w and 40w. 6 tips. Unbreakable handle. 2 and 3 wire neoprene cords.

## DESOLDERING IRONS

Pencil style. Safety light. Some operate at 40w, idle at 20w. 8 tip sizes. 2 and 3 wire neoprene cords.

## SOLDERING & DESOLDERING KITS

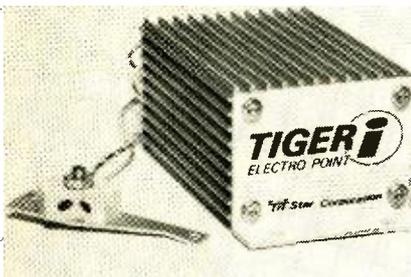
Everything needed to solder or desolder or both. All in a handy lifetime metal box with hasp.

See your distributor or write ...

## Enterprise Development Corp.

5127 E. 65th St. • Indianapolis IN 46220  
PHONE (317) 251-1231

CIRCLE 8 ON FREE INFORMATION CARD



## save on gas! save on tune-ups! save on maintenance!

Electronic ignition is "IN"! So says Detroit.

Update your car with either a TIGER CD or a TIGER I breakerless system.

Enjoy the benefits of better gas mileage, quicker starting, elimination of tune-ups, 50,000 miles on points and plugs, and reduced maintenance expenses.

TIGER MAX CD	\$69.95
TIGER 500 CD	59.95
TIGER SST CD	42.95
SIMPLIKIT CD	31.95
TIGER I	45.95

Postpaid U.S.A. only.

## Tri-Star Corporation

Dept. WW, P.O. Box 1727  
Grand Junction, Colorado 81501

116 CIRCLE 21 ON FREE INFORMATION CARD

## ADVERTISING INDEX

RADIO-ELECTRONICS does not assume any responsibility for errors that may appear in the index below.

### Free Information Number Page

44	Allison Automotive	110
67	American Audioport	30
45	American Technology	103
3	A P Products	36
61	Arrow Fasteners	18

72	B&K-Division of Dynascan	Cover II
4	Blonder-Tongue	25
81	British Industries	2
36	Brooks Radio & TV	109

	CIE-Cleveland Institute of Electronics	52-55
5	Cobra-Div. of Dynascan	Cover IV
63	Continental Specialties	94
	CREI-Div. of McGraw-Hill Continuing Education	62-65

23	Delta Products	105
28	Dynaco	26

1.2	Edmund Scientific	34,134
70	EICO	14
	E&L Instruments	28
7	Elenco Electronics	112
	EMC-Electronic Measurement Corp.	114
51	Empire Scientific	98
8	Enterprise Development	116
35	E.T.I.-Electronics Technical Institute-Division of Technical Home Study Schools	90-93

9	Fidelity Sound	100
---	----------------	-----

10	Grantham School of Electronics	115
37	General Electric-TV Receivers/Product Service	33

79	HAL Communications	103
100	Heath	19-20
11	Hickok	24
66	Hufco Labs	106

12	Indiana Home Study Institute	106
39	International Crystal	108
	IMS	22

50	Jandy	38
----	-------	----

64	Lectrotech	108
----	------------	-----

34	McGraw-Hill	13
47	MTS	1
14	Mountain West Alarm Supply	110
33	MTI	111

15	National Camera	110
	National Technical Schools	72-75
	NRI-Division of McGraw-Hill Continuing Education	8-11

74	PAIA Electronics	112
38	Perma-Power	112
32	Pomona	16
52	Prentice Hall	21
54	PTS Electronics	34

27	Radio Shack	23
	RCA Distributor & Special Products	88-89,100-101
29	Rye Industries	113

### Free Information Number Page

	H.W. Sams & Co.	37
30	Sansui Electronics	35
31	SBE	15
24	Schober Organ	101
75	Sencore	113
82	Shure Brothers	107
19	Simpson Electronics	17
65	Soundguard	39
	GTE Sylvania-Consumer Renewal	27,40
76	Southwest Technical Products	85

20	TAB BOOKS	102
59,60	Telematic-Div. of UXL	29,87
49	Tektronix	31
21	Tri-Star	116

78	Vaco Products	Cover III
57	Veras Systems/Div. of Solid State Sales	104
69	VIZ Manufacturing	99

	Webster Dictionary	7
68	Western Electronics	32

22	Xcelite Electronics-Div. of Cooper Industries	5
----	---	---

### MARKET CENTER

80	Active Electronics	123
	American Used Computer	122
	ATV Research	126

	Karel Barta	119
108	Babyon Electronics	119

	CFR Associates	119
	Command Productions	119
	Consumertronics	120

53	Delta Electronics	132
	Devtronix Organ Products	126
73	Digi-Key	122

	Fair Radio Sales	120
55	Fordham Radio Supply	128
6	Formula International	133

26	Bill Godbout Electronics	119
----	--------------------------	-----

71	Hobby-tronix	126
----	--------------	-----

	Information Unlimited	122
	Interfab	119
13	International Electronics	129

40	Jade	125
41,42,43	James Electronics	127,130,131

	Lab Science	126
	Lakeside Industries	122

62	Meshna Electronics	126
25	Morrow's Micro-Stuff	132

56	New-Tone Electronics	128
16	Nexus Trading	122

17	Olson Electronics	132
----	-------------------	-----

18	Poly Paks	124
----	-----------	-----

48	Quest	120
----	-------	-----

	Saxitone Tape Sales	126
	SD Sales	121
58	Solid State Sales	120

	Trintronics Limited	119
	Trumbell	122

	Valley West	119
	Vantage Press	119
	Visulex	122,126

# Market Center

**CLASSIFIED COMMERCIAL RATE** (for firms or individuals offering commercial products or services). **\$1.40 per word** . . . minimum 15 words.

**NONCOMMERCIAL RATE** (for individuals who want to buy or sell personal items) **85¢ per word** . . . no minimum.

**ONLY FIRST WORD AND NAME** set in bold caps. Additional bold face (not available as all caps) at 10¢ per word. Payment must accompany all ads except those placed by accredited advertising agencies. 10% discount on 12 consecutive insertions, if paid in advance. All copy subject to publisher's approval. Advertisements using P.O. Box address will not be accepted until advertiser supplies publisher with permanent address and phone number. Copy to be in our hands on the 26th of the third month preceding the date of the issue (i.e. August issue closes May 26). When normal closing date falls on Saturday, Sunday or a holiday, issue closes on preceding working day.

## BUSINESS OPPORTUNITIES

### HIGHLY PROFITABLE ONE-MAN ELECTRONIC FACTORY

Investment unnecessary, knowledge not required, sales handled by professionals. Ideal home business. Write today for facts! Postcard will do. Barta-BJ, Box 248, Walnut Creek, CA 94597.

## EDUCATION & INSTRUCTION

DC regulated supplies—\$2.00, operational amplifiers—\$2.00. Design, build, use, and troubleshoot through understanding. An engineer authors. Technical Information Department, JAKUSH ENTERPRISES, Box 875, Troy, NY 12181

### F.C.C. EXAM MANUAL

PASS FCC EXAMS! Memorize, study—Tests—Answers for FCC 1st and 2nd class Radio-telephone licenses. Newly revised multiple choice questions and diagrams cover all areas tested in FCC exams, plus Self-Study Ability Test. \$9.95 postpaid. Money-back guarantee.



COMMAND PRODUCTIONS P.O. Box 26348 E  
RADIO ENGINEERING DIV. SAN FRANCISCO, CAL. 94126

PASS FCC examinations! Proven topical questions-answers cover First, Second, Third licenses. \$6.95. EGW PUBLICATIONS, Box 5516-FJ, Walnut Creek, CA 94596

### ELECTRONICS DESIGN NEWSLETTER

Learn Design Techniques!  
★ Logic Design Techniques  
★ Digital & Linear Design Theory & Procedures  
★ Construction Projects  
Write for FREE CATALOG of parts & kits!  
Subscription \$6 Sample Copy \$1  
VALLEY WEST Box 2119-L Sunnyvale, CA 94087

TELEPHONE bugged? Don't be Watergated! Countermeasures brochure \$1.00. NEGEYE LABORATORIES, Box 547-RE, Pennsboro, WV 26415

FREE educational electronics catalog. Home study courses. Write to: EDUKITS WORKSHOP, Dept. 284G, Hewlett, NY 11557

### KITS:

**VIDEO GAMES TV CLOCK**  
11:23:55

**TV CLOCK & GAMES DIGITAL CLOCK KITS COIN GAME BINARY NUMBER GAME**

TV/FM AMPS - POWER SUPPLIES

SEND \$5 FOR YOUR INFO. PACK, refunded with purchase. We have the BEST kits at the BEST price! DO IT TODAY!!!

INTERFAB, 27959C CABOT ROAD, LAGUNA NIGUEL, CA. 92677

## ELECTRONIC MUSIC SYNTHESIS/ANALOG PROCESSING

•PLANS & KITS •CIRCUIT THEORY  
•INDUSTRIAL R&D TECHNIQUES  
•PARTS & COMPONENTS  
featuring: STATE-OF-THE-ART technology, and professional-lab quality designs at **LOW COST BUILD**:  
• Ultra wide range universal V.C.O.  
• Voltage controlled filters & amplifiers  
• Joystick controlled filters & faders  
• plus MUCH MUCH MORE

WRITE NOW

Free information... send self addressed, stamped envelope to

**C F R ASSOCIATES**  
P.O. Box F Newton, N.H. 03858

"the oldest name in synthesis for the experimenter"

LEARN basic digital troubleshooting by correspondence. **EDUCATIONAL TECHNOLOGIES**, Dept. RE, Box 224, Reynoldsburg, OH 43068

GET into broadcasting! Become a DJ—get free records, tapes, equipment. Earn big money! Start own station. Free details. **EGW**, Box 5516-FJ, Walnut Creek, CA 94596

## WANTED

QUICK cash . . . for electronic equipment, components, unused tubes. Send list now! **BARRY**, 512 Broadway, New York, NY 10012, 212 Walker 5-7000

## AUTHORS WANTED BY NEW YORK PUBLISHER

Leading book publisher seeks manuscripts of all types: fiction, non-fiction, poetry, scholarly and juvenile works, etc. New authors welcomed. For complete information, send for free booklet V-95. Vantage Press, 516 W. 34 St., New York 10001

## FOR SALE

**NOW!** For Canadian Consumers & Hobbyists; **LOW PRICED, QUALITY PARTS** by mail

Featuring TTL, CMOS, LEDs, Linear, Transistors, etc. Prices like . . . For complete catalogue, send 25¢ for handling to:  
CMOS 4000 \$24 TTL74LS02 \$45  
CMOS4049 .86 741mini-dip .45  
CMOS4011 .29 resistors .06  
TTL7440 .29 switching P.O. Box 181, Station G, Toronto, Ont M4M 3G7  
TTL74L04 .86 diodes .05  
**TRINTRONICS LTD.**

**Timmonics Limited**

TELETYPE equipment for beginners—experienced computer enthusiast. Teletype machines, parts, supplies. Catalog \$1.00. **ATLANTIC SALES**, 3730 Nautilus, Brooklyn, NY 11224. Tel: (212) 372-0349

# GODBOUT

BILL GODBOUT ELECTRONICS  
BOX 2355, OAKLAND AIRPORT, CA 94614

## 74LS TTL

1/5 THE POWER OF TTL BUT NO SPEED PENALTY					
00 \$0.36	22 \$0.38	124 \$2.50	168 \$1.87		
01 0.36	27 0.38	132 1.50	169 1.87		
02 0.36	30 0.36	138 1.38	175 1.35		
04 0.42	32 0.38	139 1.38	221 1.38		
08 0.38	37 0.53	155 1.38	258 1.38		
10 0.36	38 0.53	157 1.25	273 2.25		
11 0.38	42 1.25	160 1.85	367 1.00		
20 0.36	74 0.56	162 1.85	368 1.00		
21 0.38	75 0.85	163 1.85	377 1.88		

BRAND NEW—74S471 8 x 256 high speed bipolar ROM in standard DIP . . . \$9.50

## low profile sockets

HERE'S YOUR CHANCE TO BUY SOME TOP QUALITY SOLDERABLE SOCKETS AT THE RIGHT PRICE.

14 PIN . . . 10/92-1.95	16 PIN . . . 10/92-1.15
18 PIN . . . 10/92-7.50	20 PIN . . . 10/93-1.10
22 PIN . . . 10/93-3.50	24 PIN . . . 10/93-6.60
36 PIN . . . 10/95-5.50	40 PIN . . . 10/96-1.15

## Now! assembled ECONORAM \$129.95

Our famous ECONORAM 4K x 8 RAM board is now available built, tested, and warranted for one year. Plug it in to your Altair 8800 or IMSAI and enjoy the same performance that has made the kit such a success—guaranteed zero wait states and current drain of 750 ma or less; on board regulation, easy address selection, and lots more. Available in kit form for \$99.95.

## 100 PIN EDGE CONNECTOR--NEW!

Gold plated 3 level wire wrapping posts. Ideal for Altair/IMSAI boards. \$5 EACH OR 5/\$22

TERMS: Orders under \$10 add 50¢; Cal res add tax; no COD. Mastercharge®/BAC® call 415-357-7007, 24 hr.

CIRCLE 26 ON FREE INFORMATION CARD

## Babylon-Pac super SALE! \$1.98

All parts are first quality (no fallout), tested and guaranteed.

<b>Linear pac</b> 8 assorted linear in mini-DIP or 70S-741, 00 amp, 40000 oh amp, 1W, 703 RF-IF amp, with data and circuits \$1.98	<b>Flip-Flop pac</b> 10 assorted Flip-Flops, Dual JK's, RST's, and low power FF's, with data \$1.98	<b>Regulators</b> 4 LM273 DIP variable regulators, 2-40V, with data \$1.98
<b>TTL Gates</b> 15 assorted DIP's 7400 series-7420, 7430, 7440, etc. All prime, marked parts, with data \$1.98	<b>LED pac</b> 10 assorted discrete LED's-green, red, and infra-red, with data \$1.98	<b>Comparator pac</b> 5 assorted DIP's-LM311, 710, 711, with data \$1.98
<b>UNTESTED PACS</b> <b>CMOS pac</b> 30 Untested CMOS IC's. All factory marked. \$1.98	<b>Stud Rectifiers</b> 20 5 amp stud rectifiers. Untested, mostly 100V+ \$1.98	<b>Resistors</b> 100 resistors of any single standard value from 2.7 ohm to 1M ohm. Not ass't. \$1.98
<b>Transistors</b> 40 assorted 0.1W to 1W, PNP and NPN, Darlington. Untested, all connections guaranteed \$1.98	<b>IC Assortment</b> 100 untested IC's, all DIP, mostly TTL—some marked, unmarked, or unmarked \$1.98	<b>Switches</b> 8 SPST momentary contact push button N.O. Red button fits in approx. 1" panel, with lock washer and mounting nut \$1.98
<b>Diodes</b> 100 germanium computer signal diodes with leads trimmed for PCB mounting. \$1.98	<b>739 pac</b> 5 linear—dual low noise stereo amplifier 739, with data. \$1.98	Buy 5 pac for \$9.90 and pic-a-pac for 10¢

PCB vertical mount dipped tantalum capacitors—all brand new marked parts. Values: 1000F 25V, 6.8mF 6V, 33mF 10V, 4.7mF 16V

**25¢ each**

**NPN TO3 POWER TRANSISTORS**  
2N2905 PD-111 VCE-60V HFE-50 2N3053 2N3055 2N3056 2N3057 2N3058 2N3059 2N3060 2N3061 2N3062 2N3063 2N3064 2N3065 2N3066 2N3067 2N3068 2N3069 2N3070 2N3071 2N3072 2N3073 2N3074 2N3075 2N3076 2N3077 2N3078 2N3079 2N3080 2N3081 2N3082 2N3083 2N3084 2N3085 2N3086 2N3087 2N3088 2N3089 2N3090 2N3091 2N3092 2N3093 2N3094 2N3095 2N3096 2N3097 2N3098 2N3099 2N3100 2N3101 2N3102 2N3103 2N3104 2N3105 2N3106 2N3107 2N3108 2N3109 2N3110 2N3111 2N3112 2N3113 2N3114 2N3115 2N3116 2N3117 2N3118 2N3119 2N3120 2N3121 2N3122 2N3123 2N3124 2N3125 2N3126 2N3127 2N3128 2N3129 2N3130 2N3131 2N3132 2N3133 2N3134 2N3135 2N3136 2N3137 2N3138 2N3139 2N3140 2N3141 2N3142 2N3143 2N3144 2N3145 2N3146 2N3147 2N3148 2N3149 2N3150 2N3151 2N3152 2N3153 2N3154 2N3155 2N3156 2N3157 2N3158 2N3159 2N3160 2N3161 2N3162 2N3163 2N3164 2N3165 2N3166 2N3167 2N3168 2N3169 2N3170 2N3171 2N3172 2N3173 2N3174 2N3175 2N3176 2N3177 2N3178 2N3179 2N3180 2N3181 2N3182 2N3183 2N3184 2N3185 2N3186 2N3187 2N3188 2N3189 2N3190 2N3191 2N3192 2N3193 2N3194 2N3195 2N3196 2N3197 2N3198 2N3199 2N3200 2N3201 2N3202 2N3203 2N3204 2N3205 2N3206 2N3207 2N3208 2N3209 2N3210 2N3211 2N3212 2N3213 2N3214 2N3215 2N3216 2N3217 2N3218 2N3219 2N3220 2N3221 2N3222 2N3223 2N3224 2N3225 2N3226 2N3227 2N3228 2N3229 2N3230 2N3231 2N3232 2N3233 2N3234 2N3235 2N3236 2N3237 2N3238 2N3239 2N3240 2N3241 2N3242 2N3243 2N3244 2N3245 2N3246 2N3247 2N3248 2N3249 2N3250 2N3251 2N3252 2N3253 2N3254 2N3255 2N3256 2N3257 2N3258 2N3259 2N3260 2N3261 2N3262 2N3263 2N3264 2N3265 2N3266 2N3267 2N3268 2N3269 2N3270 2N3271 2N3272 2N3273 2N3274 2N3275 2N3276 2N3277 2N3278 2N3279 2N3280 2N3281 2N3282 2N3283 2N3284 2N3285 2N3286 2N3287 2N3288 2N3289 2N3290 2N3291 2N3292 2N3293 2N3294 2N3295 2N3296 2N3297 2N3298 2N3299 2N3300 2N3301 2N3302 2N3303 2N3304 2N3305 2N3306 2N3307 2N3308 2N3309 2N3310 2N3311 2N3312 2N3313 2N3314 2N3315 2N3316 2N3317 2N3318 2N3319 2N3320 2N3321 2N3322 2N3323 2N3324 2N3325 2N3326 2N3327 2N3328 2N3329 2N3330 2N3331 2N3332 2N3333 2N3334 2N3335 2N3336 2N3337 2N3338 2N3339 2N3340 2N3341 2N3342 2N3343 2N3344 2N3345 2N3346 2N3347 2N3348 2N3349 2N3350 2N3351 2N3352 2N3353 2N3354 2N3355 2N3356 2N3357 2N3358 2N3359 2N3360 2N3361 2N3362 2N3363 2N3364 2N3365 2N3366 2N3367 2N3368 2N3369 2N3370 2N3371 2N3372 2N3373 2N3374 2N3375 2N3376 2N3377 2N3378 2N3379 2N3380 2N3381 2N3382 2N3383 2N3384 2N3385 2N3386 2N3387 2N3388 2N3389 2N3390 2N3391 2N3392 2N3393 2N3394 2N3395 2N3396 2N3397 2N3398 2N3399 2N3400 2N3401 2N3402 2N3403 2N3404 2N3405 2N3406 2N3407 2N3408 2N3409 2N3410 2N3411 2N3412 2N3413 2N3414 2N3415 2N3416 2N3417 2N3418 2N3419 2N3420 2N3421 2N3422 2N3423 2N3424 2N3425 2N3426 2N3427 2N3428 2N3429 2N3430 2N3431 2N3432 2N3433 2N3434 2N3435 2N3436 2N3437 2N3438 2N3439 2N3440 2N3441 2N3442 2N3443 2N3444 2N3445 2N3446 2N3447 2N3448 2N3449 2N3450 2N3451 2N3452 2N3453 2N3454 2N3455 2N3456 2N3457 2N3458 2N3459 2N3460 2N3461 2N3462 2N3463 2N3464 2N3465 2N3466 2N3467 2N3468 2N3469 2N3470 2N3471 2N3472 2N3473 2N3474 2N3475 2N3476 2N3477 2N3478 2N3479 2N3480 2N3481 2N3482 2N3483 2N3484 2N3485 2N3486 2N3487 2N3488 2N3489 2N3490 2N3491 2N3492 2N3493 2N3494 2N3495 2N3496 2N3497 2N3498 2N3499 2N3500 2N3501 2N3502 2N3503 2N3504 2N3505 2N3506 2N3507 2N3508 2N3509 2N3510 2N3511 2N3512 2N3513 2N3514 2N3515 2N3516 2N3517 2N3518 2N3519 2N3520 2N3521 2N3522 2N3523 2N3524 2N3525 2N3526 2N3527 2N3528 2N3529 2N3530 2N3531 2N3532 2N3533 2N3534 2N3535 2N3536 2N3537 2N3538 2N3539 2N3540 2N3541 2N3542 2N3543 2N3544 2N3545 2N3546 2N3547 2N3548 2N3549 2N3550 2N3551 2N3552 2N3553 2N3554 2N3555 2N3556 2N3557 2N3558 2N3559 2N3560 2N3561 2N3562 2N3563 2N3564 2N3565 2N3566 2N3567 2N3568 2N3569 2N3570 2N3571 2N3572 2N3573 2N3574 2N3575 2N3576 2N3577 2N3578 2N3579 2N3580 2N3581 2N3582 2N3583 2N3584 2N3585 2N3586 2N3587 2N3588 2N3589 2N3590 2N3591 2N3592 2N3593 2N3594 2N3595 2N3596 2N3597 2N3598 2N3599 2N3600 2N3601 2N3602 2N3603 2N3604 2N3605 2N3606 2N3607 2N3608 2N3609 2N3610 2N3611 2N3612 2N3613 2N3614 2N3615 2N3616 2N3617 2N3618 2N3619 2N3620 2N3621 2N3622 2N3623 2N3624 2N3625 2N3626 2N3627 2N3628 2N3629 2N3630 2N3631 2N3632 2N3633 2N3634 2N3635 2N3636 2N3637 2N3638 2N3639 2N3640 2N3641 2N3642 2N3643 2N3644 2N3645 2N3646 2N3647 2N3648 2N3649 2N3650 2N3651 2N3652 2N3653 2N3654 2N3655 2N3656 2N3657 2N3658 2N3659 2N3660 2N3661 2N3662 2N3663 2N3664 2N3665 2N3666 2N3667 2N3668 2N3669 2N3670 2N3671 2N3672 2N3673 2N3674 2N3675 2N3676 2N3677 2N3678 2N3679 2N3680 2N3681 2N3682 2N3683 2N3684 2N3685 2N3686 2N3687 2N3688 2N3689 2N3690 2N3691 2N3692 2N3693 2N3694 2N3695 2N3696 2N3697 2N3698 2N3699 2N3700 2N3701 2N3702 2N3703 2N3704 2N3705 2N3706 2N3707 2N3708 2N3709 2N3710 2N3711 2N3712 2N3713 2N3714 2N3715 2N3716 2N3717 2N3718 2N3719 2N3720 2N3721 2N3722 2N3723 2N3724 2N3725 2N3726 2N3727 2N3728 2N3729 2N3730 2N3731 2N3732 2N3733 2N3734 2N3735 2N3736 2N3737 2N3738 2N3739 2N3740 2N3741 2N3742 2N3743 2N3744 2N3745 2N3746 2N3747 2N3748 2N3749 2N3750 2N3751 2N3752 2N3753 2N3754 2N3755 2N3756 2N3757 2N3758 2N3759 2N3760 2N3761 2N3762 2N3763 2N3764 2N3765 2N3766 2N3767 2N3768 2N3769 2N3770 2N3771 2N3772 2N3773 2N3774 2N3775 2N3776 2N3777 2N3778 2N3779 2N3780 2N3781 2N3782 2N3783 2N3784 2N3785 2N3786 2N3787 2N3788 2N3789 2N3790 2N3791 2N3792 2N3793 2N3794 2N3795 2N3796 2N3797 2N3798 2N3799 2N3800 2N3801 2N3802 2N3803 2N3804 2N3805 2N3806 2N3807 2N3808 2N3809 2N3810 2N3811 2N3812 2N3813 2N3814 2N3815 2N3816 2N3817 2N3818 2N3819 2N3820 2N3821 2N3822 2N3823 2N3824 2N3825 2N3826 2N3827 2N3828 2N3829 2N3830 2N3831 2N3832 2N3833 2N3834 2N3835 2N3836 2N3837 2N3838 2N3839 2N3840 2N3841 2N3842 2N3843 2N3844 2N3845 2N3846 2N3847 2N3848 2N3849 2N3850 2N3851 2N3852 2N3853 2N3854 2N3855 2N3856 2N3857 2N3858 2N3859 2N3860 2N3861 2N3862 2N3863 2N3864 2N3865 2N3866 2N3867 2N3868 2N3869 2N3870 2N3871 2N3872 2N3873 2N3874 2N3875 2N3876 2N3877 2N3878 2N3879 2N3880 2N3881 2N3882 2N3883 2N3884 2N3885 2N3886 2N3887 2N3888 2N3889 2N3890 2N3891 2N3892 2N3893 2N3894 2N3895 2N3896 2N3897 2N3898 2N3899 2N3900 2N3901 2N3902 2N3903 2N3904 2N3905 2N3906 2N3907 2N3908 2N3909 2N3910 2N3911 2N3912 2N3913 2N3914 2N3915 2N3916 2N3917 2N3918 2N3919 2N3920 2N3921 2N3922 2N3923 2N3924 2N3925 2N3926 2N3927 2N3928 2N3929 2N3930 2N3931 2N3932 2N3933 2N3934 2N3935 2N3936 2N3937 2N3938 2N3939 2N3940 2N3941 2N3942 2N3943 2N3944 2N3945 2N3946 2N3947 2N3948 2N3949 2N3950 2N3951 2N3952 2N3953 2N3954 2N3955 2N3956 2N3957 2N3958 2N3959 2N3960 2N3961 2N3962 2N3963 2N3964 2N3965 2N3966 2N3967 2N3968 2N3969 2N3970 2N3971 2N3972 2N3973 2N3974 2N3975 2N3976 2N3977 2N3978 2N3979 2N3980 2N3981 2N3982 2N3983 2N3984 2N3985 2N3986 2N3987 2N3988 2N3989 2N3990 2N3991 2N3992 2N3993 2N3994 2N3995 2N3996 2N3997 2N3998 2N3999 2N4000 2N4001 2N4002 2N4003 2N4004 2N4005 2N4006 2N4007 2N4008 2N4009 2N4010 2N4011 2N4012 2N4013 2N4014 2N4015 2N4016 2N4017 2N40



Same day shipment. First line parts only. Factory tested. Guaranteed money back. Quality IC's and other components at factory prices.

**INTEGRATED CIRCUITS**

7400 TTL	SN74LS10N	39	NE566V	1.85	74C03	28	
SN7400N	17	SN74LS20N	34	NE567V	1.25	74C04	33
SN7402N	17	SN74LS28N	41	SN75451CN	39	74C10	28
SN7404N	18	SN74LS30N	34	SN75452CN	39	74C20	29
SN7410N	17	SN74LS32N	39	SN75453CN	39	74C20	29
SN7414N	63	SN74LS74N	59	SN75482	55	74C48	295
SN7415N	34	SN74LS75N	75	SN75494	3.00	74C74	75
SN7417N	39	SN74LS80N	110			IN4733A	27
SN7420N	17	SN74LS93N	119			IN4736A	27
SN7430N	20	SN74LS99N	189			IN4739A	27
SN7438N	25	SN74LS107N	52			IN4742A	27
SN7439N	25	SN74LS107N	52			IN4744A	27
SN7440N	17	SN74LS151N	128			IN4751A	27
SN7447N	36	SN74LS157N	140			IN4752A	27
SN7450N	17	SN74LS158N	200			IN4754A	27
SN7473N	36	SN74LS191N	200			IN4758	27
SN7474N	32	SN74LS259N	220			IN4758	27
SN7475N	48	LINEAR				2102-1	1.80
SN7476N	32	LM3082	1.90	CD4014	2.00	2107B	6.00
SN7483N	70	CA3089	2.75	CD4016	55	2112-2	7.90
SN7486N	39	LM3011A	3.50	CD4017	1.00	3314	6.50
SN7489N	45	LM3012	3.50	CD4018	1.35	MM5262	30
SN7490N	45	LM3091	89	CD4019	2.00	MM5268	2.20
SN7492N	45	LM3092	89	CD4020	2.00	MM5268	2.20
SN7493N	49	LM3093	95	CD4021	2.00	MM5268	2.20
SN7494N	75	LM3094	135	CD4022	2.00	MM5268	2.20
SN74100N	90	LM311H	90	CD4023	2.00	MM5268	2.20
SN74101N	39	LM324N	1.10	CD4024	1.50	MM5268	2.20
SN74102N	39	LM324N	1.10	CD4025	1.50	MM5268	2.20
SN74103N	39	LM324N	1.10	CD4026	1.50	MM5268	2.20
SN74104N	39	LM324N	1.10	CD4027	1.50	MM5268	2.20
SN74105N	39	LM324N	1.10	CD4028	1.50	MM5268	2.20
SN74106N	39	LM324N	1.10	CD4029	1.50	MM5268	2.20
SN74107N	39	LM324N	1.10	CD4030	1.50	MM5268	2.20
SN74108N	39	LM324N	1.10	CD4031	1.50	MM5268	2.20
SN74109N	39	LM324N	1.10	CD4032	1.50	MM5268	2.20
SN74110N	39	LM324N	1.10	CD4033	1.50	MM5268	2.20
SN74111N	39	LM324N	1.10	CD4034	1.50	MM5268	2.20
SN74112N	39	LM324N	1.10	CD4035	1.50	MM5268	2.20
SN74113N	39	LM324N	1.10	CD4036	1.50	MM5268	2.20
SN74114N	39	LM324N	1.10	CD4037	1.50	MM5268	2.20
SN74115N	39	LM324N	1.10	CD4038	1.50	MM5268	2.20
SN74116N	39	LM324N	1.10	CD4039	1.50	MM5268	2.20
SN74117N	39	LM324N	1.10	CD4040	1.50	MM5268	2.20
SN74118N	39	LM324N	1.10	CD4041	1.50	MM5268	2.20
SN74119N	39	LM324N	1.10	CD4042	1.50	MM5268	2.20
SN74120N	39	LM324N	1.10	CD4043	1.50	MM5268	2.20
SN74121N	39	LM324N	1.10	CD4044	1.50	MM5268	2.20
SN74122N	39	LM324N	1.10	CD4045	1.50	MM5268	2.20
SN74123N	39	LM324N	1.10	CD4046	1.50	MM5268	2.20
SN74124N	39	LM324N	1.10	CD4047	1.50	MM5268	2.20
SN74125N	39	LM324N	1.10	CD4048	1.50	MM5268	2.20
SN74126N	39	LM324N	1.10	CD4049	1.50	MM5268	2.20
SN74127N	39	LM324N	1.10	CD4050	1.50	MM5268	2.20
SN74128N	39	LM324N	1.10	CD4051	1.50	MM5268	2.20
SN74129N	39	LM324N	1.10	CD4052	1.50	MM5268	2.20
SN74130N	39	LM324N	1.10	CD4053	1.50	MM5268	2.20
SN74131N	39	LM324N	1.10	CD4054	1.50	MM5268	2.20
SN74132N	39	LM324N	1.10	CD4055	1.50	MM5268	2.20
SN74133N	39	LM324N	1.10	CD4056	1.50	MM5268	2.20
SN74134N	39	LM324N	1.10	CD4057	1.50	MM5268	2.20
SN74135N	39	LM324N	1.10	CD4058	1.50	MM5268	2.20
SN74136N	39	LM324N	1.10	CD4059	1.50	MM5268	2.20
SN74137N	39	LM324N	1.10	CD4060	1.50	MM5268	2.20
SN74138N	39	LM324N	1.10	CD4061	1.50	MM5268	2.20
SN74139N	39	LM324N	1.10	CD4062	1.50	MM5268	2.20
SN74140N	39	LM324N	1.10	CD4063	1.50	MM5268	2.20
SN74141N	39	LM324N	1.10	CD4064	1.50	MM5268	2.20
SN74142N	39	LM324N	1.10	CD4065	1.50	MM5268	2.20
SN74143N	39	LM324N	1.10	CD4066	1.50	MM5268	2.20
SN74144N	39	LM324N	1.10	CD4067	1.50	MM5268	2.20
SN74145N	39	LM324N	1.10	CD4068	1.50	MM5268	2.20
SN74146N	39	LM324N	1.10	CD4069	1.50	MM5268	2.20
SN74147N	39	LM324N	1.10	CD4070	1.50	MM5268	2.20
SN74148N	39	LM324N	1.10	CD4071	1.50	MM5268	2.20
SN74149N	39	LM324N	1.10	CD4072	1.50	MM5268	2.20
SN74150N	39	LM324N	1.10	CD4073	1.50	MM5268	2.20
SN74151N	39	LM324N	1.10	CD4074	1.50	MM5268	2.20
SN74152N	39	LM324N	1.10	CD4075	1.50	MM5268	2.20
SN74153N	39	LM324N	1.10	CD4076	1.50	MM5268	2.20
SN74154N	39	LM324N	1.10	CD4077	1.50	MM5268	2.20
SN74155N	39	LM324N	1.10	CD4078	1.50	MM5268	2.20
SN74156N	39	LM324N	1.10	CD4079	1.50	MM5268	2.20
SN74157N	39	LM324N	1.10	CD4080	1.50	MM5268	2.20
SN74158N	39	LM324N	1.10	CD4081	1.50	MM5268	2.20
SN74159N	39	LM324N	1.10	CD4082	1.50	MM5268	2.20
SN74160N	39	LM324N	1.10	CD4083	1.50	MM5268	2.20
SN74161N	39	LM324N	1.10	CD4084	1.50	MM5268	2.20
SN74162N	39	LM324N	1.10	CD4085	1.50	MM5268	2.20
SN74163N	39	LM324N	1.10	CD4086	1.50	MM5268	2.20
SN74164N	39	LM324N	1.10	CD4087	1.50	MM5268	2.20
SN74165N	39	LM324N	1.10	CD4088	1.50	MM5268	2.20
SN74166N	39	LM324N	1.10	CD4089	1.50	MM5268	2.20
SN74167N	39	LM324N	1.10	CD4090	1.50	MM5268	2.20
SN74168N	39	LM324N	1.10	CD4091	1.50	MM5268	2.20
SN74169N	39	LM324N	1.10	CD4092	1.50	MM5268	2.20
SN74170N	39	LM324N	1.10	CD4093	1.50	MM5268	2.20
SN74171N	39	LM324N	1.10	CD4094	1.50	MM5268	2.20
SN74172N	39	LM324N	1.10	CD4095	1.50	MM5268	2.20
SN74173N	39	LM324N	1.10	CD4096	1.50	MM5268	2.20
SN74174N	39	LM324N	1.10	CD4097	1.50	MM5268	2.20
SN74175N	39	LM324N	1.10	CD4098	1.50	MM5268	2.20
SN74176N	39	LM324N	1.10	CD4099	1.50	MM5268	2.20
SN74177N	39	LM324N	1.10	CD4100	1.50	MM5268	2.20
SN74178N	39	LM324N	1.10	CD4101	1.50	MM5268	2.20
SN74179N	39	LM324N	1.10	CD4102	1.50	MM5268	2.20
SN74180N	39	LM324N	1.10	CD4103	1.50	MM5268	2.20
SN74181N	39	LM324N	1.10	CD4104	1.50	MM5268	2.20
SN74182N	39	LM324N	1.10	CD4105	1.50	MM5268	2.20
SN74183N	39	LM324N	1.10	CD4106	1.50	MM5268	2.20
SN74184N	39	LM324N	1.10	CD4107	1.50	MM5268	2.20
SN74185N	39	LM324N	1.10	CD4108	1.50	MM5268	2.20
SN74186N	39	LM324N	1.10	CD4109	1.50	MM5268	2.20
SN74187N	39	LM324N	1.10	CD4110	1.50	MM5268	2.20
SN74188N	39	LM324N	1.10	CD4111	1.50	MM5268	2.20
SN74189N	39	LM324N	1.10	CD4112	1.50	MM5268	2.20
SN74190N	39	LM324N	1.10	CD4113	1.50	MM5268	2.20
SN74191N	39	LM324N	1.10	CD4114	1.50	MM5268	2.20
SN74192N	39	LM324N	1.10	CD4115	1.50	MM5268	2.20
SN74193N	39	LM324N	1.10	CD4116	1.50	MM5268	2.20
SN74194N	39	LM324N	1.10	CD4117	1.50	MM5268	2.20
SN74195N	39	LM324N	1.10	CD4118	1.50	MM5268	2.20
SN74196N	39	LM324N	1.10	CD4119	1.50	MM5268	2.20
SN74197N	39	LM324N	1.10	CD4120	1.50	MM5268	2.20
SN74198N	39	LM324N	1.10	CD4121	1.50	MM5268	2.20
SN74199N	39	LM324N	1.10	CD4122	1.50	MM5268	2.20
SN74200N	39	LM324N	1.10	CD4123	1.50	MM5268	2.20
SN74201N	39	LM324N	1.10	CD4124	1.50	MM5268	2.20
SN74202N	39	LM324N	1.10	CD4125	1.50	MM5268	2.20
SN74203N	39	LM324N	1.10	CD4126	1.50	MM5268	2.20
SN74204N	39	LM324N	1.10	CD4127	1.50	MM5268	2.20
SN74205N	39	LM324N	1.10	CD4128	1.50	MM5268	2.20
SN74206N	39	LM324N	1.10	CD4129	1.50	MM5268	2.20
SN74207N	39	LM324N	1.10	CD4130	1.50	MM5268	2.20
SN74208N	39	LM324N	1.10	CD4131	1.50	MM5268	2.20
SN74209N	39	LM324N</					

# S. D. SALES CO.

P. O. BOX 28810 - C  
DALLAS, TEXAS 75228

## 4K LOW POWER RAM BOARD KIT

THE WHOLE WORKS

Imsai and Altair 8080 plug in compatible. Uses low power static 21L02-1 500 ns. RAM's, which are included. Fully buffered, drastically reduced power consumption, on board regulated, all sockets and parts included. Premium quality plated thru PC Board.

# \$89.95

8 Digit LED  
"METRIC MASTER"

## \$19.95

"RAPID MAN - 12"

## \$29.95

### \$1,000,000 CALCULATOR PURCHASE!

We bought the entire stock of a major manufacturer. New, guaranteed units.

Five functions PLUS complete Metric Conversion functions. Rechargeable batteries. Small, hand held size. With AC charger.

12 Digit - Desk Top Style. Sturdy design. With memory and four complete functions. Big, bright display.

### ALARM CLOCK KIT SIX DIGIT LED

Thousands of hobbyists have bought and built our original clock kit and were completely satisfied. But we have received many requests for an alarm clock kit with the same value and quality that you have come to expect from S. D. So, here it is! THE KIT INCLUDES:

- 1 Mostek 50252 Alarm Clock Chip
- 6 Hewlett Packard, 30 in. common cathode readouts
- 15 NPN Driver Transistors
- 2 Switches for time set
- 2 Slide Switches for alarm set and enable
- 1 Filter Cap
- 4 IN4002 Rectifiers
- 1 IN914 Diode
- 1 .01 Disc Cap
- 15 Resistors
- 1 Speaker for alarm
- 1 LED lamp for PM indicator

## \$9.95

PCB - \$3.00  
XFMR - \$1.50

### 60 HZ CRYSTAL TIME BASE - FOR DIGITAL CLOCKS

## \$5.95

#### KIT FEATURES:

- A. 60 hz output with accuracy comparable to a digital watch
  - B. Directly interfaces with all MOS Clock chips
  - C. Super low power consumption (1.5 Ma typ.)
  - D. Uses latest MOS 17 stage divider IC
  - E. Eliminates forever the problem of AC line glitches
  - F. Perfect for cars, boats, campers, or even for portable clocks at ham field days. BUY TWO FOR \$10.00!
  - G. Small size, can be used in existing enclosures.
- KIT INCLUDES CRYSTAL, DIVIDER IC, PC BOARD PLUS ALL OTHER NECESSARY PARTS AND SPECS.

### MOTOROLA RTL IC'S

Brand new, factory prime. Hard to find, but still used in a variety of projects. (See the RTL Cookbook by Howard W. Sams.)

- |              |              |               |
|--------------|--------------|---------------|
| MC724P - 59c | MC780P - 89c | MC791P - 69c  |
| MC725P - 59c | MC785P - 49c | MC792P - 59c  |
| MC764P - 49c | MC787P - 89c | MC799P - 59c  |
| MC767P - 69c | MC788P - 49c | MC970P - 89c  |
| MC771P - 49c | MC789P - 59c | MC9709P - 69c |
| MC775P - 89c | MC790P - 89c | MC9760P - 69c |

### TTL INTEGRATED CIRCUITS

- |             |            |             |              |
|-------------|------------|-------------|--------------|
| 7400 - 19c  | 7430 - 19c | 7476 - 35c  | 74153 - 75c  |
| 7402 - 19c  | 7432 - 34c | 7480 - 49c  | 74154 - 1.00 |
| 74L04 - 29c | 7437 - 39c | 7483 - 95c  | 74157 - 75c  |
| 74S04 - 44c | 7438 - 39c | 7485 - 95c  | 74161 - 95c  |
| 7404 - 19c  | 7440 - 19c | 7586 - 45c  | 74164 - 1.10 |
| 7406 - 29c  | 7447 - 85c | 7490 - 65c  | 74165 - 1.10 |
| 7408 - 19c  | 7448 - 85c | 7492 - 75c  | 74174 - 95c  |
| 7410 - 19c  | 7451 - 19c | 7495 - 75c  | 74181 - 2.50 |
| 7411 - 29c  | 7453 - 19c | 7496 - 89c  | 74191 - 1.25 |
| 7413 - 50c  | 7473 - 39c | 74121 - 38c | 74192 - 1.25 |
| 7420 - 19c  | 7474 - 35c | 74123 - 65c | 74193 - 1.00 |
|             | 7575 - 35c | 74141 - 75c | 74195 - 69c  |

### "CUBO" - DIGITAL ALARM CLOCK CUBE A PERFECT GIFT - NOT A KIT!



The CUBO Alarm Clock mfg. by Corvus, division of MOSTEK CORP. Originally sold for \$49.95. We bought out their entire inventory. All new, individually gift boxed. Mini size (2 1/2" cube) with maxi performance.

- FEATURES:
- A. 4 Digit H.P. Bright Display
  - B. "Second Hand" LED Activity Indicator
  - C. 24 Hour Alarm; 12 hour real time format
  - D. 10 Minute Snooze
  - E. Auto Display Dimming - Adjusts to Ambient Light
  - F. AM/PM Indicator
  - G. Power Failure Indicator
- Uses Famous Mostek MK50250 MOS LSI IC

## \$14.95 EACH

(Add 75c P.&H.)



### 1000 MFD FILTER CAPS

Rated 35 WVDC. Upright style with P. C. leads. Most popular value for hobbyists. Compare at up to \$1.19 each from franchise type electronic parts stores. S.D. SPECIAL 4 for \$1.

### SLIDE SWITCH ASSORTMENT

Our best seller. Includes miniature and standard sizes, single and multi-position units. All new, first quality, name brand. Try one package and you'll re-order more. SPECIAL - 12/\$1.



### MOTOROLA POWER DARLINGTON

Back in Stock!

Like MJ3001. NPN 80V, 10A. HFE 6000 TYP. TO-3 case. We include a free 723 C volt reg. with schematic for power supply. SPECIAL - \$1.99

### WESTERN DIGITAL UART

No. TR1602B. 40 pin DIP. This is a very powerful and popular part.

NEW - \$6.95 with data  
LIMITED QUANTITY

### FAIRCHILD BIG LED READOUTS

A big .50 inch easy to read character. Now available in either common anode or common cathode. Take your pick. Super low current drain, only 5 MA per segment typical.

- YOUR CHOICE: 6 for \$7.50
- FND - 510 Common Anode \$1.50 ea.
  - FND - 503 Common Cathode \$1.50 ea.

### INTEL 1702A 2K ERASEABLE PROM'S \$6.95

We tell it like it is. We could have said these were factory new, but here is the straight scoop. We bought a load of new computer gear that contained a quantity of 1702A's in sockets. We carefully removed the parts verified their quality, and are offering them on one heck of a deal. First come, first served. Satisfaction guaranteed.

BACK IN STOCK!

### RESISTOR ASSORTMENT

1/4 W 5% and 10%. PC leads. A good mix of values. 200/\$2.

### 74S200

256 Bit High Speed RAM  
Same as 82516

## \$3.95

### 1K PROM BACK IN STOCK!

825129. 256X4. Bipolar, 50 NS. FAST. WITH SPECS.

## \$3.95

### 8T97B

Hex Tri-State Buffer. Back in stock.

## \$1.25

### UP YOUR COMPUTER!

#### 21L02-1 1K LOW POWER 500 NS STATIC RAM

TIME IS OF THE ESSENCE

And so is power. Not only are our RAM's faster than a speeding bullet but they are now very low power. We are pleased to offer prime new 21L02 - 1 low power and super fast RAM's. Allows you to STRETCH your power supply farther and at the same time keep the wait light off.

8 FOR \$17.50

### SALE ON CUT LEAD SEMICONDUCTORS

Leads were cut for PCB insertion. Still very useable. All new, unused. Some House no.

- 1N914/1n4148 . . . . . 100/\$2.
- 1N4002 1 Amp 100 PIV. . . . . 40/\$1.
- 1N4745A 16V 1W Zener. . . . . 20/\$1.
- EN222 NPN Transistor . . . . . 25/\$1.
- EN2907 PNP Transistor . . . . . 25/\$1.
- 2N3904 NPN Driver Xstr. . . . . 25/\$1.
- 2N3392 GE Pre-amp Xstr. . . . . 25/\$1.
- C103Y SCR. 800MA 60V . . . . . 10/\$1.

### C&K MINI TOGGLE SWITCH

No. 7103 SUB MINI SPDT Center OFF.

SPECIAL - 99c

#### TERMS:

Money Back Guarantee. No COD. Texas Residents add 5% tax. Add 5% of order for postage and handling. Orders under \$10. add 75c. Foreign orders: US Funds ONLY!

CALL YOUR BANK AMERICARD OR MASTER CHARGE ORDER IN ON OUR CONTINENTAL UNITED STATES TOLL FREE WATTS: 1-800-527-3460

Texas Residents Call Collect  
214/271-0022

S. D. SALES  
P. O. Box 28810 - C  
Dallas, Texas 75228

ORDERS OVER \$15. CHOOSE \$1. FREE MERCHANDISE

CIRCLE 77 ON FREE INFORMATION CARD

# 100 PIN EDGE CONNECTORS

**\$5.00** FIT  
IMSAI/ALTAIR  
(NEW)  
incl. Postage & Handling

## COMPUTER WAREHOUSE STORE

584 COMMONWEALTH AVE.,  
BOSTON, MA 02215

FREE catalog. Calculators \$4.95 each, ultrasonic devices, digital thermometers, strobe light kits, memories, photographic electronic flash units, rechargeable batteries, LED's, transistors, IC's, piezoelectric crystals, toroidal cores, unique components. CHANEY'S, Box 27038, Denver, CO 80227



The  
United Way

# CLOCKS

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

WITH BLACK PLASTIC CASE \$34.95 ppd.  
WITHOUT CASE \$29.95 ppd.  
ASSEMBLED AND TESTED \$45.95 ppd.

MM 5320 TV CAMERA SYNC GENERATOR - this LSI chip supplies the basic sync functions for either color or monochrome 525 line/60 Hz. camera and video applications. The price is \$4.95 ppd. and includes the data sheet.

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

Flyer available - write for it or circle the reader service card.

**NEXUS**  
TRADING  
CO.  
Box 3357  
San Leandro, Ca 94578

CIRCLE 16 ON FREE INFORMATION CARD

## BLINK 'N' BOOPER

IS HERE!!!  
The Memory Concentration Timing Game.

Send \$1.00 (refundable with order) for illustrative information packet... includes technical description circuit functions, component line-up, and game dynamics.

visulex P.O. Box 4204R Mountain View, CA 94040

**SURPRISE!** Build inexpensively, the most unusual test instruments, futuristic gadgets using numerical readouts! Catalogue free! GBS, Box 100B, Greenbank, WV 24944

### PICTURE TUBE MACHINE

We have sold over 5000 and USED - CHEAP - available in electronic component stores. Buy with CONFIDENCE from the ORIGINAL MFG.

For complete details send name, address zip code to:  
LAKEVIEW INDUSTRIES  
3520 W. Fullerton Ave  
Chicago, IL 60647  
Phone: 312-342-3399

### QUALITY ELECTRONIC COMPONENTS

NEW DISCOUNT SCHEDULE SAVES YOU EVEN MORE!

**8080A \$29.95** **2102-1 \$1.99**  
MICROPROCESSOR 1024 Bit Random Access Memory  
0-70°C 480 ns Clock Period 500 ns Max Access Time

INTEGRATED CIRCUITS - TTL, CMOS, LINEAR & MOS

7400	21	7473	.30	74174	.90	4001	23	4073	.23
7401	21	7474	.30	74175	.93	4002	23	4075	.23
7402	21	7475	.49	74176	.79	4006	22	4081	.23
7403	21	7476	.42	74177	.79	4017	23	4082	.23
7404	21	7480	.70	74180	.70	4008	79	4502	.79
7405	21	7482	.70	74181	2.15	4009	44	4510	1.14
7406	25	7483	.70	74182	.79	4010	44	4511	1.05
7407	25	7485	.89	74184	2.19	4011	23	4514	2.80
7408	21	7486	.78	74185	2.19	4012	23	4515	2.80
7409	21	7489	2.19	74188	3.50	4013	40	4516	1.23
7410	21	7493	.44	74192	.88	4014	30	4518	1.14
7411	21	7491	.70	74190	1.23	4015	96	4520	1.14
7412	21	7492	.44	74191	1.23	4016	40	4527	1.68
7413	25	7493	.44	74192	.88	4017	1.05	4528	.88
7414	89	7495	.70	74193	.88	4018	1.05	4585	1.23
7415	25	7495	.70	74194	.88	4019	23	LM309K	1.80
7417	25	7496	.70	74195	.88	4020	1.14	LM324N	1.25
7420	25	74128	.40	74196	.88	4021	1.14	LM3900N	1.25
7421	25	74107	.30	74197	.88	4022	96	LM340T-6	1.25
7423	35	74109	.33	74198	1.49	4023	23	LM340T-8	1.25
7425	35	74121	.35	74199	1.49	4024	84	LM340T-12	1.25
7426	25	74122	.35	74251	1.09	4025	23	LM340T-15	1.25
7427	33	74123	.61	74279	.58	4026	1.68	LM340T-18	1.25
7428	28	74125	.40	74365	.67	4027	40	LM340T-24	1.25
7430	21	74136	.40	74366	.67	4028	89	LM3900N	.88
7432	25	74132	.70	74367	.67	4029	1.14	NE536T	2.04
7433	30	74141	.88	74368	.67	4030	23	NE540L	2.04
7437	25	74145	.70	75150	1.31	4033	1.51	NE555V	4.08
7438	25	74147	.63	75450	.88	4034	1.30	NE556A	.88
7440	21	74148	.30	75451	.61	4035	1.14	NE560B	3.83
7441	88	74150	1.16	75452	.61	4040	1.14	NE561B	3.83
7442	53	74151	.63	75453	.61	4041	.79	NE562B	3.83
7443	63	74153	.65	75454	.61	4042	.79	NE565A	2.25
7444	63	74154	1.03	75491	.81	4043	.70	NE566V	.28
7445	70	74155	.70	75589	.84	4044	.70	NE567V	.36
7446	70	74156	.70	75493	1.09	4046	1.86	uA709CV	.44
7447	70	74157	.70	75494	1.19	4049	.40	uA710CA	.44
7448	70	74160	.88	8093	.40	4050	.40	uA711 CA	.53
7450	21	74161	.88	8094	.40	4051	1.26	uA723CA	.60
7453	21	74162	.88	8095	.67	4052	1.26	uA741CV	.44
7454	21	74163	.88	8096	.67	4053	1.26	uA747CA	.70
7460	31	74164	.96	8097	.67	4060	1.58	uA748CV	.49
7460	30	74166	1.26	8098	.67	4066	.79	MC1458V	.79
7472	30	74170	1.64	82525	2.19	4071	23	2102	1.99
		74173	2.42	4000	.23	4072	23	8080A	29.95

### BISHOP GRAPHICS Printed Circuit Drafting

Aids are now available from Digi-Key

#### DATA BOOKS

TTL IC's - 592 pages	... \$4.00	INTERFACE IC's - 464 pages	\$4.00
LINEAR IC's - 704 pages	... \$4.00	VOLTAGE REGULATORS - 128 pages	... \$3.00
CMOS IC's - 256 pages	... \$3.00	LINEAR APPLICATIONS - 432 pages	... \$4.00
TRANSISTORS - 288 pages	... \$3.00		
MEMORY IC's - 592 pages	... \$3.00		

#### SILICON TRANSISTORS

MPS918, MPS930, MPS2222A, MPS2369A, MPS2717, MPS2907A, MPS3392, MPS3393, MPS3394, MPS3395, MPS3563, MPS3565, MPS3568, MPS3638A, MPS3640, MPS3641, MPS3643, MPS3645, MPS3646, 2N3904, 2N3906, 2N4124, 2N4126, 2N4401, 2N4403, 2N4410, PN4888, 2N5087, 2N5089, PN5129, PN5133, PN5134, PN5137, PN138, PN5139, 2N5210, PN5964, 16, \$1.55/10, \$13.60/100 of same part no.

MPF102 36 \$30.00/C 2N5457 48 \$41.00/C MP5413 28 \$24.00/C 2N3055 99 \$85.00/C

#### AP SUPER STRIP II - Universal Breadboarding

Element with 840 Solderless Plug-In Tie-Points  
**\$17.00**

#### LED DISPLAYS

FNDS37 C.C. 375'x1.75'	\$1.75	1N5226B 3.3v 15 111/C	1N5226B 7.5v 15 111/C
FNDS50 C.C. 500'x1.75'	\$1.75	1N5227B 3.6v 15 111/C	1N5227B 8.2v 15 111/C
FNDS07 C.C. 500'x1.75'	\$1.75	1N5228B 3.9v 15 111/C	1N5228B 8.7v 15 111/C
FNDB00 C.C. 800'x1.75'	\$3.50	1N5229B 4.3v 15 111/C	1N5229B 9.1v 15 111/C
FNDB07 C.C. 800'x1.75'	\$3.50	1N5230B 4.7v 15 111/C	1N5230B 15 111/C
		1N5231B 5.1v 15 111/C	1N5231B 15 111/C
		1N5232B 5.6v 15 111/C	1N5232B 12v 15 111/C
NSLS053 T-14	18c	1N5233B 6.0v 15 111/C	1N5233B 13v 15 111/C
NSLS056 T-14	18c	1N5234B 6.2v 15 111/C	1N5234B 15 111/C
		1N5235V 6.8v 15 111/C	1N5235V 15v 15 111/C

#### 1/2 WATT ZENER DIODES

Send for free catalog or mail reader service card.

2.56 1/4 Screw .99/C 7.20/M  
2.56 1/4 Screw .99/C 7.65/M  
4.40 1/4 Screw .55/C 3.60/M  
4.40 1/4 Screw .60/C 4.05/M  
6.32 1/4 Screw .65/C 4.40/M  
6.32 1/4 Screw .75/C 4.85/M  
8.32 3/8 Screw .90/C 5.85/M  
2.56 Hex Nut .55/C 3.60/M  
4.40 Hex Nut .55/C 3.75/M  
6.32 Hex Nut .60/C 4.00/M  
8.32 Hex Nut .60/C 4.15/M  
No. 2 Lockwasher .65/C 5.75/M  
No. 4 Lockwasher .45/C 3.00/M  
No. 6 Lockwasher .45/C 3.00/M  
No. 8 Lockwasher .45/C 3.00/M

#### HARDWARE

Send for free catalog or mail reader service card.

2.56 1/4 Screw .99/C 7.20/M  
2.56 1/4 Screw .99/C 7.65/M  
4.40 1/4 Screw .55/C 3.60/M  
4.40 1/4 Screw .60/C 4.05/M  
6.32 1/4 Screw .65/C 4.40/M  
6.32 1/4 Screw .75/C 4.85/M  
8.32 3/8 Screw .90/C 5.85/M  
2.56 Hex Nut .55/C 3.60/M  
4.40 Hex Nut .55/C 3.75/M  
6.32 Hex Nut .60/C 4.00/M  
8.32 Hex Nut .60/C 4.15/M  
No. 2 Lockwasher .65/C 5.75/M  
No. 4 Lockwasher .45/C 3.00/M  
No. 6 Lockwasher .45/C 3.00/M  
No. 8 Lockwasher .45/C 3.00/M

#### REED RELAYS

1.5 Amp SPST N.O.  
CANTONICS

4.8V Coil	\$1.70	\$125/C
6.0V Coil	\$1.70	\$125/C
12V Coil	\$1.70	\$125/C
24V Coil	\$1.70	\$125/C

#### 1/4 WATT 5% CARBON FILM RESISTORS

5c each in multiples of 5 per value  
\$1.70/100 of same value. 10 ohm to 1.0 meg

#### WIRE WRAPPING WIRE

Pre-cut and stripped Kynar insulated wire from 1.0" to 15.0" in length. Also sold in bulk lengths.

#### RESISTOR ASSORTMENTS

1 see all 10% 1/4 W. Val. from 2.2 to 22 meg (425 pcs) \$12.00  
2 see all 10% 1/4 W. Val. from 10 to 5.6 meg (350 pcs) \$12.00

#### VOLUME DISCOUNT SCHEDULE

Merchandise Total	Merchandise Total	Discount
\$ 0.00-24.99	NET	\$ 100.00-599.99 LESS 10%
\$ 25.00-99.99	LESS 10%	\$ 600.00-999.99 LESS 20%
\$ 100.00 & up	LESS 25%	\$1000.00 & up LESS 25%

Then Add the Standard Charge Below  
STANDARD SHIPPING/HANDLING CHARGE

If your merchandise total after discount is between:  
\$ 0.00-5.99 add \$2.00 \$ 5.00-99.99 add \$0.25  
\$ 100.00-499.99 add \$0.75 \$1000.00 & up No Charge  
\$ 25.00-549.99 add \$0.50  
Includes shipping & insurance to USA & Canada

COD ORDERS ACCEPTED FOR SAME DAY SHIPMENT - CALL 218-681-6674

## PRINTED CIRCUIT

Positive Acting Photo Resist; Carbide bits; Bubble etchers; Artwork; Epoxy Glass Boards.

Send stamp & address label for flyer

### TRUMBULL

833 Balra Dr., El Cerrito, CA 94530

SEMICONDUCTOR and parts literature. J. & J. ELECTRONICS, Box 1437R, Winnipeg, Manitoba, Canada. U.S. Inquiries Invited.

### AMAZING ELECTRONIC PROJECTS and PRODUCTS:

Lasers Super Powered, Burning, Cutting, Rifle, Pistol, Pocket. See in Dark—Shotgun Directional Mike—Unscramblers—Giant Tesla—Stunwand—TV Disrupter—Energy Producing, Surveillance, Detection, Electrifying, Ultrasonic, CB, Auto and Mech. Devices, Hundreds More—All New Plus INFO UNLTD PARTS SERVICE. Catalog \$1. Information Unlimited, Box 626, Lord Jeffery Court, Amherst, N.H. 03031.

### NATIONAL MA1001A DIGITAL ALARM CLOCK MODULE

with Transformer and Switches  
**\$12.95!**

MA1001A \$9.50 when purchased without transformer & switches

#### FEATURES:

- Bright 4 Digit 0.5" LED Display
- Assembled & Tested Module. You only need connect transformer & switches
- 12 Hour Format with PM Indicator
- 50 or 60 Hz Operation
- Power Failure Indication
- Brightness Control Capability
- Alarm and Snooze Timers
- Compact 3.0"x1.75"

A Great Bargain, but Quantities are limited - So Order Now!

### TRIAL-TO-220 PACKAGE TO AMP/400 VOLT 50c

### TRANSFORMER Pri 120 V. Sec. 12V 300 Ma. \$1.00

**TTL 7400N**

SN7400N	.15	SN74121N	.36
SN7401N	.15	SN74122N	.42
SN7402N	15	SN74123N	59
SN7403N	15	SN74125N	.45
SN7404N	18	SN74126N	.45
SN7405N	18	SN74128N	.65
SN7405N	18	SN74132N	.84
SN7406N	.34	SN74136N	.64
SN7407N	.34	SN74141N	.93
SN7408N	18	SN74142N	3.70
SN7409N	18	SN74143N	3.98
SN7410N	15	SN74144N	3.98
SN7411N	21	SN74145N	.89
SN7412N	28	SN74147N	1.68
SN7413N	41	SN74148N	1.25
SN7414N	79	SN74150N	.99
SN7416N	26	SN74151N	.63
SN7417N	31	SN74153N	.63
SN7420N	15	SN74154N	.99
SN7421N	21	SN74155N	.78
SN7422N	21	SN74156N	.69
SN7423N	27	SN74157N	.64
SN7425N	27	SN74159N	2.50
SN7426N	24	SN74160N	.89
SN7427N	.27	SN74161N	.89
SN7428N	.35	SN74162N	.89
SN7430N	15	SN74163N	.89
SN7432N	24	SN74164N	1.10
SN7433N	35	SN74165N	.99
SN7437N	23	SN74166N	1.19
SN7439N	23	SN74167N	2.98
SN7440N	23	SN74168N	1.75
SN7442N	38	SN74172N	8.75
SN7443N	85	SN74173N	1.29
SN7444N	85	SN74174N	.99
SN7445N	.74	SN74175N	.89
SN7446AN	78	SN74176N	.79
SN7447AN	78	SN74177N	.78
SN7448N	.74	SN74178N	1.25
SN7450N	.15	SN74179N	1.60
SN7451N	.15	SN74180N	.69
SN7453N	.15	SN74181N	1.99
SN7454N	.15	SN74182N	.69
SN7460N	.15	SN74183N	1.99
SN7470N	28	SN74185AN	1.95
SN7472N	27	SN74186N	6.95
SN7473N	31	SN74188N	3.50
SN7474N	31	SN74190N	1.09
SN7475N	.48	SN74191N	1.09
SN7476N	.34	SN74192N	.88
SN7480N	.39	SN74193N	.88
SN7481AN	.99	SN74194N	.94
SN7482N	59	SN74195N	59
SN7483AN	.69	SN74196N	.93
SN7484AN	1.65	SN74197N	.83
SN7485N	.88	SN74198N	1.69
SN7486N	.32	SN74199N	1.69
SN7489N	1.95	SN74221N	1.20
SN7490AN	.65	SN74246N	1.95
SN7491AN	64	SN74247N	1.85
SN7492AN	46	SN74248N	1.75
SN7493AN	46	SN74249N	1.75
SN7494N	.74	SN74251N	1.40
SN7495AN	69	SN74265N	.85
SN7496N	.69	SN74278N	2.45
SN7497N	2.85	SN74279N	.59
SN74100N	.99	SN74283N	1.45
SN74104N	43	SN74294N	4.50
SN74105N	43	SN74285N	4.50
SN74107N	29	SN74290N	.85
SN74109N	49	SN74293N	.85
SN74110N	54	SN74298N	1.98
SN74111N	.74	SN74351N	1.92
SN74116N	1.75	SN74365N	.65
SN74120N	1.40	SN74366N	.65
		SN74367N	.65
		SN74368N	.65
		SN74390N	1.40
		SN74393N	1.40
		SN74490N	1.90

**TTL LOW POWER SCHOTTKY**

SN74LS00N	.25	SN74LS138N	1.49
SN74LS01N	.25	SN74LS139N	1.49
SN74LS02N	.25	SN74LS145N	1.25
SN74LS03N	.25	SN74LS151N	1.25
SN74LS04N	.30	SN74LS153N	1.25
SN74LS05N	.30	SN74LS155N	1.45
SN74LS08N	.25	SN74LS156N	1.45
SN74LS09N	.25	SN74LS157N	1.25
SN74LS10N	.25	SN74LS158N	1.20
SN74LS11N	.25	SN74LS160N	1.95
SN74LS12N	.25	SN74LS161N	1.95
SN74LS13N	.69	SN74LS162N	1.95
SN74LS14N	1.35	SN74LS163N	1.95
SN74LS15N	.25	SN74LS164N	1.98
SN74LS20N	.25	SN74LS168N	2.25
SN74LS21N	.25	SN74LS169N	2.25
SN74LS22N	.25	SN74LS170N	2.80
SN74LS24N	.40	SN74LS174N	.40
SN74LS27N	.30	SN74LS175N	1.40
SN74LS28N	.30	SN74LS181N	3.50
SN74LS30N	.25	SN74LS190N	1.95
SN74LS32N	.37	SN74LS191N	1.95
SN74LS33N	.39	SN74LS192N	1.95
SN74LS37N	.39	SN74LS193N	1.95
SN74LS38N	.39	SN74LS194A	1.40
SN74LS40N	.30	SN74LS195A	1.40
SN74LS42N	1.10	SN74LS196N	1.45
SN74LS48N	1.10	SN74LS197N	1.45
SN74LS47N	1.10	SN74LS221N	1.35
SN74LS48N	1.10	SN74LS240N	2.50
SN74LS49N	1.10	SN74LS241N	2.50
SN74LS51N	.25	SN74LS242N	2.40
SN74LS54N	.25	SN74LS243N	2.40
SN74LS55N	.25	SN74LS244N	2.50
SN74LS63N	1.75	SN74LS247N	1.30
SN74LS73N	.49	SN74LS248N	1.30
SN74LS74N	.49	SN74LS249N	1.30
SN74LS75N	.69	SN74LS251N	1.55
SN74LS76N	.49	SN74LS253N	1.55
SN74LS78N	.49	SN74LS257N	1.60
SN74LS83AN	1.49	SN74LS258N	1.50
SN74LS85N	1.75	SN74LS261N	2.95
SN74LS86N	.58	SN74LS266N	.59
SN74LS90N	.99	SN74LS279N	.75
SN74LS91N	1.15	SN74LS283N	1.40
SN74LS92N	1.10	SN74LS290N	1.35
SN74LS93BN	.99	SN74LS293N	1.35
SN74LS95AN	1.60	SN74LS295AN	1.75
SN74LS96N	1.75	SN74LS298AN	1.75
SN74LS107N	.49	SN74LS324AN	2.25
SN74LS109N	.55	SN74LS352AN	1.45
SN74LS112N	.49	SN74LS353AN	1.70
SN74LS113N	.49	SN74LS365AN	1.75
SN74LS114N	.49	SN74LS366AN	.75
SN74LS122N	.89	SN74LS367AN	.75
SN74LS123N	1.09	SN74LS368AN	.75
SN74LS124N	1.95	SN74LS375AN	.80
SN74LS125N	.75	SN74LS386AN	.59
SN74LS126N	.75	SN74LS395AN	1.95
SN74LS132N	1.25	SN74LS670AN	2.95
SN74LS136N	.55		

**CMOS**

CD4000BE	.10
CD4001BE	.19
CD4002BE	.14
CD4006BE	1.19
CD4007BE	.85
CD4008BE	18
CD4009BE	.39
CD4010BE	.39
CD4011BE	.19
CD4012BE	.18
CD4013BE	.39
CD4014BE	.95
CD4015BE	.95
CD4016BE	.39
CD4017BE	.95
CD4018BE	1.09
CD4019BE	.44
CD4020BE	1.09
CD4021BE	1.15
CD4022BE	.95
CD4023BE	1.95
CD4024BE	.69
CD4025BE	18
CD4026BE	1.45
CD4027BE	.44
CD4028BE	.79
CD4029BE	.89
CD4030BE	.39
CD4033BE	1.70
CD4034BE	2.95
CD4035BE	1.05
CD4040BE	1.05
CD4041BE	.69
CD4042BE	.65
CD4043BE	.50
CD4044BE	.50
CD4049BE	.39
CD4050BE	.39
CD4051BE	1.20
CD4052BE	1.20
CD4053BE	1.25
CD4055BE	1.35
CD4056BE	1.50
CD4060BE	1.50
CD4066BE	.65
CD4068BE	.25
CD4069BE	.25
CD4070BE	.25
CD4071BE	.25
CD4072BE	.30
CD4073BE	.30
CD4075BE	.30
CD4076BE	1.10
CD4078BE	.25
CD4081BE	.25
CD4082BE	.30
CD4085BE	.75
CD4086BE	.75
CD4502BE	1.20
CD4507BE	.54
CD4510BE	1.10
CD4511BE	1.50
CD4512BE	1.20
CD4516BE	1.19
CD4518BE	.95
CD4519BE	.89
CD4520BE	.89
CD4528BE	1.25
CD4531BE	1.25
CD4539BE	1.20
CD4555BE	.75
CD4556BE	.75
CD4585BE	1.80
74C85/40085PC	1.20
74C160/40160PC	1.65
74C161/40161PC	1.65
74C162/40162PC	1.65
74C163/40163PC	1.65
74C174/40174PC	1.50
74C175/40175PC	1.50
74C192/40192PC	1.65
74C193/40193PC	1.65
74C194/40194PC	1.50
74C195/40195PC	1.50

**LED's**

<b>Litronix</b>	
IL1	1.05
IL5	1.15
IL12	6.69
IL74	.82
RL2	.23
<b>Texas Instruments</b>	
TIL111	.99
TIL112	.95
TIL113	1.25
TIL114	1.15
TIL116	1.20
TIL117	1.30
TIL118	.80
TIL119	.85
TIL138	2.25
TIL139	2.25
TIL209A	.19
TIL211	.38
TIL220	.20
TIL221	.19
TIL222	.35
TIL223	1.98
TIL24	3.95
TIL302	3.98
TIL303	3.98
TIL304	3.98
TIL305	4.95
TIL306	7.95
TIL307	7.95
TIL308	7.95
TIL309	7.95
TIL311	8.95
TIL312	1.60
TIL313	1.60
TIL31	1.50
TIL32	.85
TIL63	.95
TIL66	.75
TIL78	.60
TIL81	1.20
LS600	2.10
<b>Fairchild</b>	
FCDB02	.60
FCDB06	.60
FCDB10	.75
FCDB20A	.75
FLV117	.18
MV5054-1	.18
FND357	1.75
FND500	1.75
FND507	1.75
FND807	3.00
FNS700	.60

**Plastic Power Transistors**

TIP29A	45	TIP116	80
TIP30C	59	TIP117	90
TIP31A	52	TIP121	1.50
TIP32A	55	TIP122	1.25
TIP33C	90	TIP125	1.35
TIP41A	65	TIP127	1.60
TIP42A	.75	TIP2955	89
TIP47	88	TIP3055	85
TIP112	80		

**LINEARS**

LM301AH			.34
LM301AN-8	(mini dip)		.34
LM304H			.75
LM305H			.78
LM305AH			.90
LM307H			28
LM307N-8	(mini dip)		84
LM308H			.75
LM309H			.75
LM309K			1.15
LM311H			.89
LM311N-8	(mini dip)		.99
LM318H			1.50
LM318N-8	(mini dip)		1.25
LM323K			6.95
LM324AN			1.10
LM339N			1.20
LM555N-8	(mini dip)		.44
LM558N-14			.89
LM709CN-14			.24
LM711CN-14			.29
LM711CH			.50
LM723CH			.49
LM723CN-14			.49
LM733CN-14			.99
LM739CN-14			1.20
LM740CH			3.50
LM741CH			
LM741CN			
LM741CN-8	(mini dip)		.28
LM741CN-14			.25
LM741CN-14			.64
LM748CN	(mini dip)		.29
LM748CH			.45
LM776CN			1.50
LM776CN-8	(mini dip)		1.50
LM437N-14			.49
LM458H			.54
LM458N-8	(mini dip)		.69
LM488D			1.75
LM489D			1.75
LM3046N-14			.85
LM3302N-14			.95
LM4436N-14			1.50

We offer the largest variety of current production Texas Instruments and Fairchild Semiconductor only 74LS devices from stock. Even through the competition for current production major manufactured 74LS devices is limited, we are dedicated to provide the best prices possible. As our costs decrease, we pass the savings on to you, our customer.

**LINEAR VOLTAGE REGULATORS**

LM7800 Series	1.90	Positive Voltage Regulators	1 amp
T0-3		5, 6, 8, 12, 15, 18, 24 Volts	
LM7800 Series	1.80	Positive Voltage Regulators	
T0-5		5, 6, 8, 12, 15, 18, 24 Volts	
LM7800 Series	1.60	Positive Voltage Regulators	1 amp
(Plastic) T0-20		5, 6, 8, 12, 15, 18, 24 Volts	
LM78M00 Series	1.47	Positive Voltage Regulators	
T0-20		1/2 Amp 5, 6, 8, 12, 15, 20, 24 Volts	
LM78L00 AWC	.45	Positive Voltage Regulators	70 MA
Series T0-92		2, 5,	

# Poly Pak's EXCLUSIVE Avg. Ship. \$1.98



100'S OF BARRELS PURCHASED! TEST 'EM YOURSELF 'N SAVE!

For the first time anywhere, Poly Pak merchandisers introduce a new way in buying the economical way. Raw stock from the "barrel". Remember the "good ole days"? They're back again. The same way merchandisers throughout the United States buy from various factories... their overruns in barrels. Poly Pak has done the same. Therefore you are getting the same type of material as the RE-TESTERS DO!

YOUR CHOICE OF ANY KIT  
Every kit carries a money back guarantee!

<b>BARREL KIT #1</b> SN7400 DIP IC'S 75 for \$1.98 Cat. No. 10R2415 Untested.	<b>BARREL KIT #2</b> BEAR OP AMPS DIPS 75 for \$1.98 Un tested Cat. No. 10R2416	<b>BARREL KIT #3</b> 1N4148/91 SWITCHING DIODES 100 for \$1.98 Cat. No. 10R2418 Untested.	<b>BARREL KIT #4</b> "4000" RECTIFIERS 100 for \$1.98 Untested. Cat. No. 10R2417
<b>BARREL KIT #7</b> VOLUME CONTROL BOMANZAI 40 for \$1.98 100% good Cat. No. 10R2421	<b>BARREL KIT #11</b> POWER TAB TRANSISTORS 40 for \$1.98 Cat. No. 10R2425 Untested	<b>BARREL KIT #14</b> PRECISION RESISTORS Marked and unmarked 200 for \$1.98 No. 10R2428	<b>BARREL KIT #19</b> DIPPED MYLARS 60 for \$1.98 Cat. No. 10R2597 100% good
<b>BARREL KIT #20</b> LONG LEAD DISCS 150 for \$1.98 Cat. 10R2598 100% good	<b>BARREL KIT #25</b> METAL CAN TRANSISTORS 100 for \$1.98 Untested Cat. No. 10R2603	<b>BARREL KIT #26</b> PLASTIC TRANSISTORS 100 for \$1.98 Untested. Cat. No. 10R2604	<b>BARREL KIT #30</b> PERFORMED RESISTORS 250 for \$1.98 Cat. No. 10R2608 100% good
<b>BARREL KIT #31</b> METALLIC RESISTORS 100 for \$1.98 Cat. No. 10R2609	<b>BARREL KIT #37</b> 1 AMP "BULLET" RECTIFIERS 100 for \$1.98 Untested. Cat. No. 10R2615	<b>BARREL KIT #39</b> 2N3055 HOBBY TRANSISTORS 15 for \$1.98 100% good. Cat. No. 10R2617	<b>BARREL KIT #58</b> SLIDE SWITCHES 30 for \$1.98 No. 10R2726 100% good
<b>BARREL KIT #61</b> POLYSTYRENE CAPS 100 for \$1.98 All good. Cat. No. 10R2729	<b>BARREL KIT #68</b> 2 WATTS 100 for \$1.98 100% good. All marked. Cat. No. 10R2735	<b>BARREL KIT #71</b> CAPACITOR SPECIAL 100 pcs. \$1.98 100% good. Cat. 10R2738	<b>BARREL KIT #73</b> TRANSISTOR ELECTROS 50 for \$1.98 Cat. 10R2747
<b>BARREL KIT #76</b> 1-WATT ZENERS 100 for \$1.98 Untested. Cat. No. 10R2741	<b>BARREL KIT #86</b> HOBBY LEADS 40 for \$1.98 Untested 10R2859	<b>BARREL KIT #87</b> NATIONAL IC BOMANZA 100 for \$1.98 Untested Cat. No. 10R2860	<b>BARREL KIT #115</b> MOLEX SOCKETS 200 for \$1.98 Cat. No. 10R3144

REPEATER  
HOME OFFICE  
FACTORY SHOP

IT'S REVOLUTIONARY!  
**TOUCH TONE ENCODER KIT\***

1.25M, 2-meter and 6-meter amateur radio operators, if your rig is mobile, convert it easily to a mobile telephone station and contact your home, shop, school, factory TTE-100 touch tone encoder kit. Kit includes: Chomerics touch tone pad, Motorola MC14410 chip, trimpot, resistors, zener, diagram, and G-10 pc board. Electrical specs: 12-16 volts, 5 mils (max), 4 volts PP output. \* Less 1-MC crystal. Cat. No. 10R3385

**1995**

Cat. No.	Description	Sale	BUY 'EM SEPARATELY
10R3149	Touch Tone Pad	\$4.50	10A3383 P.C. Board
10R3382	MC14410 Chip	10.50	2.95

Never before offered (as far as we know), the latest in Digital Clock circuitry - 4-digit, 0.5" height, LED, built-in red filter, with a MM588 multi-function alarm chip, mounted on a 3 x 1 1/4 x 1/4" module. Has all necessary discrete components mounted on module by factory, to require only 8 function switches, brightness and voltage divider control, 12-16 volt filament transformer, AC line cord and case. Makes alarm display (tells you when snooze alarm triggers), Alarm display (tells you when alarm triggers).

**DIGITAL CLOCK**

MODULE WITH BUILT-IN "CHIP"

Alarm ON/OFF. Instruction and hookup diagrams. Shpg. wt. 7 ozs.

**\$1495**

Cat. No. 10R3411

**\$888**

- 3-5-6 Bladed
- 115 VAC
- Compact
- Lightweight!
- Only 4-11/16" sq. x 1 1/2" deep!

**Rotron Fans**

Now anyone can afford these neat Mullin and Centaur Fans by Rotron. Used extensively for hi-fi eqpt because of low-cost, dependable cooling, as well as flushing computers, power supplies, office equipment, light projectors, transmitters, receivers & more! Weighs only 1-lb. LOW NOISE LEVEL! Humidity & moisture resistant motor. REVERSIBLE AIR FLOW! Impedance protected. Suitable for -40F to +160F. Both 115 VAC, 3200 rpm, 15 watts, 16 amps. Hi-impact, flame retardant polycarbonate propellers in a reinforced phenolic plastic block. Blow away high prices with our Mullin and Centaur fans! Removed from new equipment. Money back guarantee.

Cat. No. 10R3108 "Mullin" 3-blade  
10R3109 "Centaur" 22" 5-blade  
10R3110 "Centaur" 6-blade

Shpg. wt. 1 1/2 lbs.

**FAIRCHILD, NATIONAL VOLTAGE REGULATOR PANIC**

**YOUR CHOICE \$1**

- 1-AMP RATING
- TO-220 OR TO-3 CASES
- POSITIVE OR NEGATIVE

3 for \$2.75  
Cat. No. 10R3449 Positive Voltage\*\*  
Cat. No. 10R3450 Negative Voltage\*\*

\*\* State voltage and case style when ordering.

**TTLs**

Type	Sale	2 for	Type	Sale	2 for
SN7400	.22	.23	SN7494	.82	.83
SN7401	.22	.23	SN7495	.82	.83
SN7402	.22	.23	SN7496	.86	.87
SN7403	.22	.23	SN74125	1.29	1.30
SN7404	.24	.25	SN74126	1.29	1.30
SN7406	.36	.37	SN74132	1.95	1.96
SN7407	.46	.47	SN74141	1.12	1.13
SN7408	.22	.23	SN74145	1.69	1.70
SN7409	.52	.53	SN74148	3.25	3.26
SN7410	.22	.23	SN74150	1.12	1.13
SN7411	.27	.28	SN74153	1.10	1.11
SN7417	.62	.63	SN74154	1.53	1.54
SN7422	.22	.23	SN74157	1.09	1.10
SN7423	.47	.48	SN74158	1.55	1.56
SN7425	.37	.38	SN74160	1.51	1.52
SN7430	.22	.23	SN74163	1.50	1.51
SN7432	.36	.37	SN74164	1.79	1.80
SN7440	.22	.23	SN74165	1.79	1.80
SN7442	.97	.98	SN74173	1.69	1.70
SN7446	.97	.98	SN74174	1.42	1.43
SN7446	1.10	1.11	SN74175	1.45	1.46
SN7447	1.10	1.11	SN74176	1.59	1.60
SN7448	1.10	1.11	SN74191	2.75	2.76
SN7450	.22	.23	SN74181	3.75	3.76
SN7451	.27	.28	SN74184	2.19	2.20
SN7473	.44	.45	SN74190	2.75	2.76
SN7475	1.00	1.01	SN74191	2.75	2.76
SN7483	.99	1.00	SN74193	1.29	1.30
SN7485	1.41	1.42	SN74195	.89	.90
SN7486	.47	.48	SN74196	2.19	2.20
SN7489	2.25	2.26	SN74198	2.25	2.26
SN7490	1.00	1.01	SN74199	2.25	2.26
SN7491	.91	.92			

**MEMORIES**

Cat. No.	Type	Sale	2 for
10R2310	8008	\$19.95	\$19.96
10R2855	2102	2.50	2.51
10R2856	2102-1	2.95	2.96
10R2847	1101	.95	.96
10R1989	1103	1.50	1.51
10R2853	5262	1.95	1.96
10R2155-A	MM5203	9.95	9.96
10R2155-B	MM5202	6.95	6.96
10R2854	1702-A	9.95	9.96

Terms: Add postage. Rated: net 30  
Phone: Wakefield, Mass. (617) 245-3829  
Retail: 16-18 Del Carmine St., Wakefield, MA  
MINIMUM ORDER — \$6.00

**POLY PAKS**

P.O. BOX 942R LYNNFIELD, MASS. 01940

C.O.D.'s MAY BE PHONED

Send for FREE Fall-Winter CATALOG

**2250** 3 for \$60.

**CITIZENS BAND POWER SUPPLY**

- 12 VDC @ 3 AMPS
- REGULATED, CONTINUOUS DUTY
- CONVERTS CB, HAM RIGS TO HOME
- COMPLETELY WIRED

CBers ATTENTION! For your CB or Ham rig, a 115V to 12VDC converter! Built-in automatic RESET circuit breaker. Powerful 3 amps (8 amp peak) makes it ideal for SSB rigs, too! Attractive walnut like metal modern-design cabinet. (5 x 1 1/2 x 2 1/4"). Big U.S. maker design. Built-in circuit breaker. Front panel has OFF-ON switch and LED light. For 115 VAC 60 cycle. Saves you many \$\$\$ too! Wt. 5 lbs. Cat. No. 10R3452

**\$495** 3 for \$12.

**ECC INDUSTRIAL SPEED CONTROL**

Repeat of a sellout! A \$30 item, made by ECC famous for semiconductor, designed and built this speed control for XEROX. Controls home, shop and industrial lighting too. Rated at 1200 watts. A very elaborate circuit for controlling many electrical and electronic devices. Easily controls speeds of electric drills, brush type motors, etc. Built with heavy duty aluminum framing. Complete with external 50K pot, for variable speed control, and series resistor. Heavy duty colored wires for 115VAC 60 cycles, and item to be controlled. 10/32 mounting stud. Outperforms our previous sellout. With hookup diagram. Use as temperature controller too. Wt. 2 lbs. Cat. No. 10R3392

**KEYBOARD & ENCODER KIT**

- Uses Encoder MOS ROM
- 7 "LED" test feature
- 4 Modes
- 63-Key keyboard

• Double sided PC board  
Outputs — standard ASCII 7 bits plus strobe

**\$5995** KIT

**\$69.95 WIRED**

Lowest price Keyboard and Encoder kit we've seen. General purpose ASCII keyboard for data terminal applications. Could be used for TV, RTTY, Code Transmission, Altair and other Mini Computers, etc. Utilizes 2-key rollover MOS memory allowing encoded outputs to be stroked out as each key is depressed. Uses double side pc board. Electronic shift lock, not mechanical on keyboard. Keyawatches, one integral assembly not individual keys. Keyboard: 63 keys (19 encoded keys) 4 mode: normal, shift and control, 3 internal function keys: shift, leach side of board, shift lock and control, 3 functions: Key Break, Here Is, Repeat, 7 additional functions (can be assigned by user).

Electrical specs: voltage requirements plus 5 volts and minus 12 volts, 200mw, negative or positive logic output, jumper selectable. Output connector. On the PC board we have A NEW KEYBOARD TEST FEATURE... 7 LEDs: These LEDs display visually the ASCII code for the depressed key. TTL compatible. Kit includes: 63 key keyboard pc board, ROM, 7 LEDs, resistors, capacitors, TTL IC's and SOCKETS. We include diagram and wiring instructions, ROM code. Wt. 7 lbs. Size overall: 13 x 5 1/2 x 2".

Cat. No. 10R3208 Keyboard & Encoder Kit \$59.95  
Cat. No. 10R3209 Keyboard & Encoder Wired 69.95

## SPECIAL OF THE MONTH

### TRANSISTORS

2N3906 MOT 12/1.00  
100/7.00

### SWITCHING DIODES

1N4148  
Switching Diodes  
20/1.00 100/4.00

### DIODES

1N4007  
12/1.00 100/6.50  
1 Watt 5% Zeners  
1N4728 to 1N4757 series  
5/1.00 100/15.00  
State Voltage — 3.3V to 51V

### SWITCHES

DPTD Slide 5/1.00 25/4.00  
V3-101-D8 10A 125V Micro 2/1.75  
311SM56 10A 125V Micro 2/1.50

### ASSORTMENT

10 different switches 1.00

SMOKE DETECTOR KIT \$29.95

### C MOS

34001	FSC	1.00
4000		4/1.00
4001		4/1.00
4002		4/1.00
4006		1.50
4007		4/1.00
4008		1.00
4009		2/1.25
4010		2/1.25
4011		3/1.00
4012		3/1.00
4013		2/1.00
4014		1.25
4015		1.50
4016		2/1.25
4017		1.25
4018		1.25
4019		2/1.25
4020		1.25
4021		1.50
4022		1.25
4023		3/1.00
4024		1.00
4025		3/1.00
4027		2/1.25
4028		1.25
4029		1.35
4030		2/1.25
4032		2/1.00
4033		2.00
4035		1.85
4040		2.45
4041		1.25
4042		1.25
4043		1.25
4044		1.25
4049		2/1.35
4050		2/1.35
4051		1.50
4052		1.50
4053		1.50
4060		3.00
4066		1.25
4069		3/1.00
4070		1.35
4071		2/1.00
4077		1.00
4081		2/1.50
4511		1.75
4512		1.75
4518		1.50
4520		1.65
4528		1.50

# CrownTec L.E.D. watches



6-Function, 1-Button Solid State. Hours, Minutes, Seconds, Day of Week, Month & Day. The CrownTec L.E.D. watch contains the finest custom designed quartz crystal to assure accuracy of 3 min. per year. Guaranteed 1 yr. from date of purchase (battery excepted).

From 29.95 up

Illustrated:  
Men's Rhodium with Leather Band \$29.95  
Ladies \$39.95

Other styles available in gold tone as well as Rhodium finish.

### LINEAR CIRCUITS

Package Codes

H-T05 K-T03 M-8 PinMin N-14 PinDip T-T0220

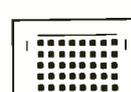
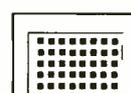
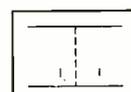
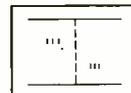
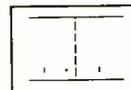
304H	Neg Reg	1.00	566H	V Cont OSC	1.50
305H	V Reg	1.00	566N(8)	V Cont OSC	1.50
306H	V Comp	2.25	567N(8)	Tone Decoder	1.50
307H	OpAmp	3/1.00	702H		1.00
307N(8)	OpAmp	3/1.00	703H	RF/IF Amp	2/1.00
308H	OpAmp	1.00	709H(14)	OpAmp	3/1.00
308N(8)	OpAmp	1.00	710H	V Comp	2/1.25
309H		1.10	710N(14)	V Comp	2/1.25
309K	5V Reg	1.25	711H	Dual Comp	2/1.00
310H	V Fol	1.15	711N(14)	Dual Comp	2/1.00
310N(8)	V Fol	1.15	723H	V Reg	2/1.00
311H	V Comp	1.00	723N(14)	V Reg	2/1.10
311N(14)	V Comp	1.00	725H	Instr OpAmp	2.00
318H	HiPerOpAmp	2.00	733H	Dif Vid Amp	1.00
318N(8)	HiPerOpAmp	1.50	733N(14)	Dif Vid Amp	1.00
320T-5V	Neg Reg	1.75	739N(14)	Dual Aud PreAmp	1.00
320T-6V	Neg Reg	1.75	740H	FET OpAmp	7.00
320T-8V	Neg Reg	1.75	741H	OpAmp	3/1.00
320T-12V	Neg Reg	1.75	741H(8)	OpAmp	3/1.00
320T-15V	Neg Reg	1.75	741N(14)	OpAmp	3/1.00
320T-18V	Neg Reg	1.75	747H	Dual OpAmp	2/1.50
323K-5V	Reg	6.00	747N(14)	Dual OpAmp	2/1.50
339N(14)	LoV Quad Comp	1.80	748H	OpAmp	3/1.25
340K-5	Pos Reg	1.95	748N(14)	OpAmp	3/1.25
340T-5V	Pos Reg	1.75	749N(14)	OpAmp	1.50
340T-8V	Pos Reg	1.75	760N(14)	Dif Vol Comp	4.25
340T-12V	Pos Reg	1.75	1303N(14)	DI Ster PreAmp	1.00
340T-15V	Pos Reg	1.75	1414N(14)	Dual Dif Comp	1.75
340T-18V	Pos Reg	1.75	1458N(8)	Dual OpAmp	2/1.00
370H	AGC/SgAmp	1.15	1488N(14)	Quad MDTL Dr	2.00
370N(14)	AGC/SgAmp	1.15	1489N(14)	Quad MDTL Dr	2.00
373N(14)	AM/FM IF Det	3.25	1496N(14)	Mod-DeMod	1.00
380N(8)	Audio Amp	1.00	2900N(14)	Quad Amp	1.00
380N(14)	Audio Amp	1.25	3065N(14)	TV Snd Sys	2/1.50
381N(14)	Dual PreAmp	1.50	3900N(14)	Quad Amp	2/1.25
531H	OpAmp	3.00	3905N(14)	Prec Timer	2/1.25
550N(14)	Prec V Reg	1.00	3909N(14)		1.25
555N(8)	Timer	2/1.00	4136N(14)	Quad 741	1.75
556N(14)	Dual Timer	1.35	4558N(14)	Dual 741	2/1.00
565N(14)	Ph Lock Loop	2.00			

## VIDEO GAME KIT 5IVE Games To Play

A CHALLENGE TO BUILD,  
A CHALLENGE TO PLAY.

Features:

1. Basic Tennis games in three variations.
2. Plus 2 variations of Wipe Out the squares. A fascinating game for 1 or 2 players. Not available in most games sold.
3. All 5 games in one kit.
4. Curve Button for added excitement.
5. On screen scoring between plays.
6. Sound.
7. Basic TTL circuitry except for VK-6 proms.
8. Requires 5V DC+ at 1/2A.



VK-1	PC Board Only Includes parts list & wiring Diagram requires VK-6	25.00
VK-2	PC Board with parts Includes PC Board, 78 IC's (those necessary are pre-programmed) resistors & capacitors to stuff the board.	125.00
VK-3	Hardware Kit Controls, switches, wire Does not include Housing.	17.50
VK-4	RF Module Kit To convert video signal to TV receiver signal. Eliminates internal "wire in" on TV set.	22.50
VK-4-A	Antenna-Game Switch Allows outside antenna to remain connected while game is in use.	9.50
VK-5	Power Supply Kit For VK-1 or VK-2 PC Board ONLY.	12.50
VK-6	PROM Set 3 Programmed DM8574N with 2 DM8130N for VK-1 (If you have plenty of TTL).	50.00

### IC SOCKETS

	LoPro	Standard	Wire Wrap
8	5/1.00	—	—
10	—	4/1.00	—
14	4/1.00	4/1.25	3/1.00
16	4/1.25	3/1.00	3/1.25
18	4/1.25	—	—
24	3/1.00	3/1.25	2/1.50
28	—	3/1.12	2/1.50

### EDGE CONNECTORS

22 Pin dual Read Out .156 2.25  
50 Pin dual Read Out .125 5.00

### LED'S

TIL312	0.3 ChHt	1.00
MAN4	0.187 ChHt	2/1.00
TIL308	0.27 CH with built in logic	4.00



# JADE Co

ELECTRONICS DISTRIBUTION

2007 W. CARSON (213) 320-1250  
P.O. BOX 4246 TORRANCE, CA. 90510

TERMS:

\$1 minimum of any one item  
\$20 minimum on BofA & M.C.  
Add \$1.00 for shipping plus \$.85 if COD  
California Residents add 6% Sales Tax

Orders from Foreign countries add appropriate postage

CIRCLE 40 ON FREE INFORMATION CARD

**AC/DC - ALARM Clock Kit - 12/24 Hr.**

**\$7.50** quantities of 1-5      **\$6.50** quantities of 6 & up

- Your choice of Display Colors - Red, Green, Blue, Amber
- Displays Hrs. & Min. - Switch to Min. & Secs. on Command.
- AM/PM Indication      • Field Tested for 6 months

The kit will include a 5316 National Clock Chip, 4 Fluorescent Display tubes, all electronic components, switches, controls & complete instructions, specs, etc. for clock and all optional Features. Other parts required or if desired are as follows:

- PC Board, Drilled & Silk Screened for Clock & all options ..... \$3.00
- Xformer (for AC oper.) — \$1.00      App. (SCR output) timer kit — \$2.00
- Speaker Alarm Kit — \$2.00      Count Down (turn-off) timer kit — \$2.00
- Crystal Time Base Kit (for DC oper.) — \$5.95
- Wood Cabinet - Walnut finish and filter — \$4.00

**Dual Range DIGITAL Voltmeter Kit**

0 to ±2 Volts DC **\$39.95** Complete    0 to ±2 Volts DC

- Features latest Technology DVM chip set    • Non Critical Comp
  - High Noise Rejection      • Accuracy to within .001
- Contains — P.C. Boards; 4-large .50 Fairchild Readouts; Display Drivers; Op-Amps; Inverter; all electronic comp; Switches, Pots; Complete Instructions and Specs; & DVM Chip Set
- Requirements: Power Supply w/+5V, +15V and -15V  
Option Avail. — 0-200V Range Extender - \$4.95

**HOBB-Y-TRONIX, INC.**

Box 511, Edison, N.J. 08817

Orders must include Check - No COD's. Add \$1.00 handling for orders under \$15.00. N.J. residents - add 5% tax.

**CIRCLE 71 ON FREE INFORMATION CARD**

**1 out of 2 who have it don't know it...**



21 million Americans have high blood pressure. But 50 percent of those who have it don't know it. When blood pressure goes higher than it should, and stays high it sets the stage for heart attack or stroke. Most cases of high blood pressure can be controlled with drugs and other advances in treatment. That's why you should see your doctor regularly. Only he can tell if you need help.

A public service message from your Heart Association



**BUILD YOUR OWN TV CAMERA!**

**Ideal for home & business**

THE ECONOMICAL ANSWER TO HOME MONITORING OF NURSERIES, ENTRANCES, DRIVEWAYS, BUSINESS AND INDUSTRIAL SURVEILLANCE, TV, AMATEUR TV PLUS HUNDREDS OF OTHER APPLICATIONS. MODEL ET-1A SERIES D - KIT FORM SIZE: ASSEMBLED SET - SOLID STATE. WORKS ON ANY TV SET. OPTIONAL SOUND KIT \$71.95. PHONE OR WRITE for catalog. Dial 402-561-2111.

BOX 453-RE    **ATV Research**    DAKOTA CITY, NE 68731

FREE catalog. IC's, Semi's. **CORONET ELECTRONICS**, 649A Notre Dame W., Montreal, Que. Canada, H3C-1H8. US Inquiries.

**EC-101 CURVE TRACKER — \$39.50 —**  
CONVERT FOUR SCOPES TO A CALIBRATED SEMI-CONDUCTOR CURVE TRACKER FOR THE LOWEST COST EVER. MEASURE GAIN, LEAKAGE, BW/CB, MATCH PAIRS, ETC. ALL CMOS. BATTERY INCLUDED. EASY TO OPERATE. MONEY BACK GUARANTEE. SEND CHECK FOR \$39.50 PLUS \$2.00 FOR POSTAGE, INS. & HANDLING. COLO. RES. ADD 3 1/2% SALES TAX.

**lab science**  
PO BOX 1972  
BOULDER, COLO. 80302

**RADIO & TV tubes** 36¢ each. One year guaranteed. Plus many unusual electronic bargains. Free catalog. **CORNELL**, 4217-E University, San Diego, CA 92105

**MANUALS** for Govt. surplus radios, test sets, scopes. List 50¢ (coin). **BOOKS**, 7218 Roanne Drive, Washington, DC 20021

**CARBON** film resistors—1/4W, 5% 10—4.7 meg-ohms for 3 1/2¢ each. Fifty per value \$0.85. Discounts available. Free samples/specifications. Other quality components. \$1.00 postage. **COMPONENTS CENTER**, Box 134R, New York, NY 10038

**JAPANESE transistors**. All transistors original factory made. Free catalog. **WEST PACIFIC ELECTRONICS**, P. O. Box 25837, W. Los Angeles, CA 90025

**PLANS & KITS**

FREE Kit Catalog contains test and experimenter's equipment. **DAGE SCIENTIFIC INSTRUMENTS**, Box 1054R, Livermore, CA 94550

**ORGAN KITS KEYBOARDS**  
THE ULTIMATE IN DESIGN AND SOUND  
FREE LITERATURE

Wurlitzer reproductions

**DEVTRONIX ORGAN PRODUCTS**, Dept. 4B  
5872 Amapola Dr. • San Jose, CA 95129

**SOMETHING** new. Build your own battery replacer—converts radio waves to 3 volt direct current—Send \$2 for complete plans—**ROBERT H. SHIMEL**, 2320-8 Abbey Drive, Fort Wayne, IN 46815

**LINEAR amplifier**, 3-30 MHz, 100-watt mobile. Construction plans, \$3.00. **WILSON**, Box 5516-FJ, Walnut Creek, CA 94596.

Affirmative means Yes!  
And there's a Federal Law that could mean yes for you.  
It says that employers with Government contracts must have affirmative action plans to hire qualified handicapped workers.

Do you know your rights?  
**Ask The President's Committee on Employment of the Handicapped**  
Washington, D.C. 20210



**VIATRON** terminal. Unused, consists of keyboard, micro-processor, control panel, video display, 2 built-in tape decks, power supply. Operates on 115v AC 60 cycle. Unused but in storage for 4 years. Due to storage, may require some work. Sold "as is" FOB Lynn, Mass. Ship wgt. 160 lbs. Has memory, automatic input/output under program control, tape search, key verification, tape validation, etc.

Send for informative data brochure. Limited quantity. \$425.00 FOB Lynn, Mass.

**JOHN MESHNA JR.**  
P.O. BOX 62  
E. LYNN, MASS. 01904



**CIRCLE 62 ON FREE INFORMATION CARD**

**DATA LIBRARY**. 9 volumes of latest information and applications from National Semiconductor, only \$27.50 postage paid. Send stamp for bargain flyer. **TRI-TEK**, 6522 N. 43rd Ave., Glendale, AZ 85301

**LOGIC** probe, dial test unit, free flyer. **VAL RESEARCH**, 13450 HWY 8, #46, Lakeside, CA 92040

**CASSETTES/LABELS**

Plain white cassette labels. Norelco cassette cleaners, famous brand cassettes. Send for open reel and cassette discount catalog. 1-9 10-99 100 1000 10M  
Cassette Labels .02 .015 .01 .006  
Norelco Cassette Cleaner .65 .60 .55 .50 .45  
10" Fiberglass used 3/4" Hole .50 .50 .40 .35 .30  
Plus Postage by Weight and Zone. Minimum Order \$5.00  
**OPEN REEL STEREO TAPE BUYERS!**

We've Got the "Spirit!" The Prices And The Address To Prove It  
**Saxitone's Bicentennial Tape Shoppe**  
1776 Columbia Rd., N.W., Wash. D.C. 20009

**RECEIVERS**, components, test equipment. Illustrated catalog 25¢. **E. FRENCH**, P.O. Box 249, Aurora, IL 60507

**Send for your information packet today—** which also includes circuit functions, component line-up and accessories. Information Packet \$1.00 (refundable with order)

**visulex** P. O. Box 4204R Mountain View, CA 94040

**CANADIAN** discount and factory clearouts catalog. Top brand stereo equipment, calculators, test gear, CB & communications, telephones. Factory dumps—government surplus. Amazing bargains. Unusual items. Rush \$1. **ETCO-RE**, 521 5th Ave., NYC, 10017

**NEW** Canadian Magazine. "Electronics Workshop", \$5.00 yearly, sample \$1.00. **ETHCO**, Box 741 "A", Montreal

# SOLID STATE TECHNOLOGY KIT

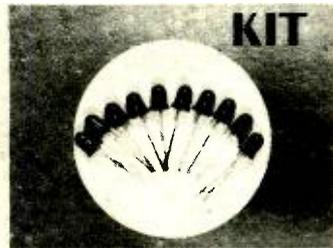
- FOR THE EXPERIMENTER WITH TASTE FOR "STATE OF THE ART" PRODUCTS
- COMPLETE SPECIFICATIONS ARE PRINTED ON THE BACK OF EACH TECHNOLOGY KIT

FTK0020

FTK0020

FTK0011

PN FTK0020  
**SOLID STATE TECHNOLOGY**



TEN RED LED LAMPS

TECHNOLOGY BY  
**FAIRCHILD**

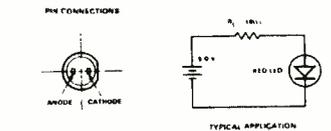
4001 MIRANDA AVENUE • PALO ALTO, CA 94304

The FTK0020 is a red light emitting diode (unencapsulated in plastic). The LED device is provided in an exterior single angle light shield with wide angle viewing. Visual light intensity is at the 570 mcd range. Typically the forward voltage  $V_f$  of a red LED is 1.7 V, and a typical current is 20 mA. The forward voltage may be used to determine the device's series LED current. The absolute maximum rating is less using the formula:

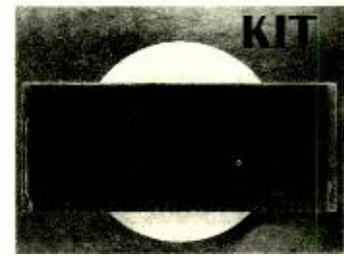
**ABSOLUTE MAXIMUM RATINGS**  
 Maximum Temperature and Humidity  
 Junction Temperature 135 C  
 Storage Temperature 180 C  
 Case Temperature (Soldering, 10 s) 260 C  
 Reverse Humidity at 95% C

**Maximum Power Dissipation**  
 Total Dissipation 100 mW  
 Dissip from 100 C 40 mW C

**Maximum Voltage and Currents**  
 Reverse Voltage 5.0 V  
 Forward DC Current 20 mA  
 Forward Peak Current (10  $\mu$ s pulse) 100 mA



PN FTK0011  
**SOLID STATE TECHNOLOGY**



24 HOUR, 0.8" HIGH CLOCK DISPLAY

TECHNOLOGY BY  
**FAIRCHILD**

4001 MIRANDA AVENUE • PALO ALTO, CA 94304

CARD FRONT

CARD BACK

CARD FRONT

DIGITS

FTK0001	0.5" High Common Cathode Digit	\$1.00
FTK0002	0.5" High Common Anode Digit	1.00
FTK0003	.357" High Common Cathode Digit	.75
FTK0004	0.8" High Common Cathode Digit	2.00
FTK0005	0.8" High Common Anode Digit	2.00

0.8" HIGH DISPLAY ARRAYS

FTK0010	12 Hour, 3 1/2 Digit Clock Display	7.00
FTK0011	24 Hour, 4 Digit Clock Display	8.00

LED LAMPS

FTK0020	10 Red LED Lamps	1.00
FTK0021	5 Mixed Colored LED Lamps	1.00
FTK0022	10 LED Mounting Clips	1.00
FTK0023	5 Three Piece LED Mounting Adapters	1.00

PHOTO TRANSISTORS

FTK0030	5 Flat Lens Photo Transistors	1.00
FTK0031	5 Round Lens Photo Transistors	1.00
FTK0032	3 Flat Lens Photo Darlington	1.00
FTK0033	3 Round Lens Photo Darlington	1.00

PHOTO ARRAYS

FTK0040	9-Element Tape Reader Array	16.00
FTK0041	12-Element Card Reader Array	24.00
FTK0042	Reflective Opto Coupler	4.00

COUPLERS

FTK0050	3 General Purpose Opto Couplers	1.00
FTK0051	Darlington Opto Coupler	1.00

MOS CLOCK CIRCUITS

FTK0400	Digital Clock/Calendar Circuit (FCM7001)	7.00
FTK0401	Digital Clock/Calendar with BCD Outputs (FCM7002)	7.00
FTK0402	Direct Drive Digital Clock Circuit with AC Output (FCM3817A)	5.00
FTK0403	Direct Drive Digital Clock Circuit with DC Output (FCM3817D)	5.00
FTK0405	Direct Drive Digital Clock/Calendar Circuit (FCM7015)	6.00

KITS

FTK0106	Automobile Clock Kit	40.00
---------	----------------------	-------

• THESE PRODUCTS ARE PACKAGED FOR OUT-STANDING WALL DISPLAY APPEARANCE

• DEALER'S AND WHOLESALER'S INQUIRIES INVITED—PRICE LIST AVAILABLE.

• FULL **FAIRCHILD** PRODUCT LINE TO FOLLOW

• BUY WITH PRIDE THE PRODUCTS BUILT BY THE INDUSTRY'S LEADER — **FAIRCHILD**

Satisfaction Guaranteed. \$5.00 Min. Order. U.S. Funds. California Residents — Add 6% Sales Tax. Send a 13c Stamp (postage) for a FREE 1976 Catalog.

*JAMES*

1021 HOWARD STREET  
SAN CARLOS, CA 94070  
PHONE ORDERS — (415) 592-8097

SEND FOR  
**FREE CATALOG  
WITH ALMOST  
3000 ITEMS**

INCLUDING  
B&K, EICO, RCA,  
FLUKE, SENCORE,  
SIMPSON, HICKOK  
and LEADER

plus a complete line  
of tubes, tools and  
electronic supplies  
at prices you won't  
believe.

**FORDHAM**

RADIO SUPPLY CO., INC.  
855R Conklin St., Farmingdale, N.Y. 11735  
Tel. (516) 752-0050

CIRCLE 55 ON FREE INFORMATION CARD

**MOVING?**

Don't miss a  
single copy of  
**Radio-Elec-  
tronics**. Give  
us:

Six weeks' no-  
tice

Your old ad-  
dress and zip  
code

Your new ad-  
dress and zip  
code

ATTACH  
LABEL  
HERE

name (please print) \_\_\_\_\_  
address \_\_\_\_\_  
city state zip code \_\_\_\_\_

Mail to: Radio-Electronics  
SUBSCRIPTION DEPT., P.O. BOX 2520,  
BOULDER, COLO. 80302

**Double up,  
America.**



When people carpool, companies benefit directly, because, obviously, fewer cars will make less demand on the parking spaces in the company lot. And some companies have attributed an increase in punctuality to the fact that more and more of their employees were carpooling.

Find out how you can help organize carpools. For your "Double up Kit," write to Double up, U.S. Department of Transportation, P.O. Box 1813, Washington, D.C. 20013.

**Two can ride cheaper  
than one.**



A Public Service of This Magazine & The Advertising Council



**CB SPECIALS—R.F. DRIVERS—R.F. POWER OUTPUTS—FETS**

2SC481	1.85	2SC767	15.75	2SC866	5.85	2SC1449-1	1.60	40081	1.50
2SC482	1.75	2SC773	.85	2SC1013	1.50	2SC1475	1.50	40082	3.00
2SC495	1.10	2SC774	1.75	2SC1014	1.50	2SC1678	5.50	2SC608	4.85
2SC502	3.75	2SC775	2.75	2SC1017	1.50	2SC1679	4.75	SK3046	2.15
2SC517	4.75	2SC776	3.00	2SC1018	1.50	2SC1728	2.15	SK3047	3.75
2SC614	3.80	2SC777	4.75	2SC1173	1.25	2SC1760	2.15	SJ2095	3.50
2SC615	3.90	2SC778	3.25	2SC1226A	4.25	2SC1816	5.50	SK3048	3.25
2SC616	4.15	2SC797	2.50	2SC1237	4.50	2SC1908	.70	SK3054	1.25
2SC617	4.25	2SC798	3.10	2SC1239	3.50	2SC1957	1.50		
2SC699	4.75	2SC781	3.00	2SC1243	1.50	2SF8	3.00	2SK19	1.75
2SC710	.70	2SC789	1.00	2SC1306	4.75	HEP-S 3001	3.25	2SK30	1.00
2SC711	.70	2SC796	3.15	2SC1306-1	4.90	2SD235	1.00	2SK33	1.20
2SC735	.70	2SC799	4.25	2SC1307	5.75	MRF8004	3.00		
2SC756	3.00	2SC802	3.75	2SC1307-1	6.00	4004	3.00	3SK40	2.75
2SC765	9.50	2SC803	4.00	2SC1377	5.50	4005	3.00	3SK45	2.75
2SC766	10.15	2SC839	.85	2SC1449	1.30	40080	1.25	3SK49	2.75

**JAPANESE TRANSISTORS**

2SA52	.60	2SB187	.60	2SC458	.70	2SC815	.75	2SC1569	1.25
2SA316	.75	2SB235	1.75	2SC460	.70	2SC828	.75	2SC1756	1.25
2SA473	.75	2SB303	.65	2SC478	.80	2SC829	.75		
2SA483	1.95	2SB324	1.00	2SC491	2.50	2SC830	1.60	2SD30	.95
2SA489	.80	2SB337	2.10	2SC497	1.60	2SC839	.85	2SD45	2.00
2SA490	.70	2SB367	1.60	2SC515	.80	2SC945	.65	2SD65	.75
2SA505	.70	2SB370	.65	2SC535	.75	2SC1010	.80	2SD68	.90
2SA564	.50	2SB405	.85	2SC536	.65	2SC1012	.80	2SD72	1.00
2SA628	.65	2SB407	1.65	2SC537	.70	2SC1051	2.50	2SD88	1.50
2SA643	.85	2SB415	.85	2SC563	2.50	2SC1061	1.65	2SD151	2.25
2SA647	2.75	2SB461	1.25	2SC605	1.00	2SC1079	3.75	2SD170	2.00
2SA673	.85	2SB463	1.65	2SC620	.80	2SC1096	1.20	2SD180	2.75
2SA679	3.75	2SB471	1.75	2SC627	1.75	2SC1098	1.15	2SD201	1.95
2SA682	.85	2SB474	1.50	2SC642	3.50	2SC1115	2.75	2SD218	4.75
2SA699	1.30	2SB476	1.25	2SC643	3.75	2SC1166	.70	2SD300	2.50
2SA699A	1.75	2SB481	2.10	2SC644	.70	2SC1170	4.00	2SD313	1.10
2SA705	.55	2SB492	1.25	2SC681	2.50	2SC1172B	4.25	2SD315	.75
2SA815	.85	2SB495	.95	2SC684	2.10	2SC1209	.55	2SD318	.95
2SA875	.85	2SB507	.90	2SC687	2.50	2SC1213	.75	2SD341	.95
2SA816	.60	2SB511	.70	2SC696	2.35	2SC1226	1.25	2SD350	3.25
				2SC712	.70	2SC1243	1.50	2SD352	.80
2SB22	.65			2SC713	.70	2SC1293	.85	2SD380	5.70
2SB54	.70	2SC206	1.00	2SC732	.70	2SC1308	4.75	2SD389	.90
2SB56	.70	2SC240	1.10	2SC733	.70	2SC1347	.80	2SD390	.75
2SB77	.70	2SC261	.65	2SC733	.70	2SC1383	.75	2SD437	5.50
2SB128	2.25	2SC291	.65	2SC739	.70	2SC1383	.75		
2SB135	.95	2SC320	2.00	2SC715	1.75	2SC1409	1.25		
2SB152	4.50	2SC352	.75	2SC762	1.90	2SC1410	1.25	MPS-U31	4.00
2SB173	.55	2SC353	.75	2SC783	1.00	2SC1447	1.25	MPS8000	1.25
2SB175	.55	2SC371	.70	2SC784	.70	2SC1448	1.25		
2SB178	1.00	2SC372	.70	2SC785	1.00	2SC1507	1.25		
2SB186	.60	2SC394	.70	2SC793	2.50	2SC1509	1.25		

**POWER-TRANSISTORS HIGH-VOLT. TV. TYPE**

BU204	1300V	3.90	BU207	1300V	5.40	2SC1172B	1100V	4.25
BU205	1500V	4.70	BU208	1500V	6.25	2SC1308	1100V	4.95
BU206	1700V	5.90	2SC1170	1100V	4.00	2SC1325	1100V	4.95

CIRCLE 56 ON FREE INFORMATION CARD

**OEM SPECIALS**

1N270	.10	2N960	.55	2N2219A	.30	2N2913	.75	2N3740	1.00	2N4401	.20
1N914	.10	2N962	.40	2N2221	.25	2N2914	1.20	2N3771	1.75	2N4402	.20
		2N967	.50	2N2221A	.30	2N2916A	3.65	2N3772	1.90	2N4403	.20
2N173	1.75	2N1136	1.35	2N2222	.25	2N3019	.50	2N3773	3.00	2N4409	.20
2N178	.90	2N1142	2.25	2N2222A	.30	2N3053	.30	2N3819	.32	2N4410	.25
2N327A	1.15	2N1302	.25	2N2270	.40	2N3054	.70	2N3823	.70	2N4416	.75
2N334	1.20	2N1305	.30	2N2322	1.00	2N3055	.75	2N3856	.20	2N4441	.85
2N336	.90	2N1377	.75	2N2323	1.00	2N3227	1.00	2N3866	.85	2N4442	.90
2N338A	1.05	2N1420	.20	2N2324	1.35	2N3247	3.40	2N3903	.20	2N4443	1.20
2N398B	.90	2N1483	.95	2N2325	2.00	2N3250	.50	2N3904	.20	2N4852	.55
2N404	.30	2N1540	.90	2N2326	2.85	2N3375	6.50	2N3905	.20	2N5061	.30
2N443	1.75	2N1543	2.70	2N2327	3.80	2N3393	.20	2N3906	.25	2N5064	.50
2N456	1.10	2N1544	.80	2N2328	4.20	2N3394	.17	2N3925	3.75	2N5130	.20
2N501A	3.00	2N1549	1.25	2N2329	4.75	2N3414	.17	2N3954	3.50	2N5133	.15
2N508A	.45	2N1551	2.50	2N2368	.25	2N3415	.18	2N3954A	3.75	2N5138	.15
2N555	.45	2N1552	3.25	2N2369	.25	2N3416	.19	2N3955	2.45	2N5198	3.75
2N652A	.85	2N1554	1.25	2N2484	.32	2N3417	.20	2N3957	1.25	2N5294	.50
2N677C	6.00	2N1557	1.15	2N2712	.18	2N3442	1.85	2N3958	1.20	2N5296	.50
2N706	.25	2N1560	2.80	2N2894	.40	2N3553	1.50	2N4037	.60	2N5306	.20
2N706B	.40	2N1605	.35	2N2903	3.30	2N3563	.20	2N4093	.85	2N5354	.20
2N711	.50	2N1613	.30	2N2904	.25	2N3565	.20	2N4124	.20	2N5369	.20
2N711B	.60	2N1711	.30	2N2904A	.30	2N3638	.20	2N4126	.20	2N5400	.40
2N718	.25	2N1907	4.10	2N2905	.25	2N3642	.20	2N4141	.20	2N5401	.50
2N718A	.30	2N2060	1.85	2N2905A	.30	2N3643	.15	2N4142	.20	2N5457	.35
2N720A	.50	2N2102	.40	2N2906	.25	2N3645	.15	2N4143	.20	2N5458	.30
2N918	.35	2N2218	.25	2N2906A	.30	2N3646	.14	2N4220A	.45	C103Y	.25
2N930	.25	2N2218A	.30	2N2907	.25	2N3730	1.50	2N4234	.95	C103d	.40
2N956	.30	2N2219	.25	2N2907A	.30	2N3731	2.75	2N4400	.20	C106B1	.50
										C106d	.75

**SILICON UNIUNCTIONS**

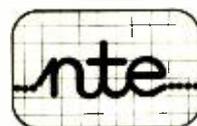
2N2646	.50	2N4871	.50
2N2647	.60	2N4891	.50
2N6027	.55	2N4892	.50
2N6028	.70	2N4893	.50
D5E37	.25	2N4894	.50
2N2160	.65	MU10	.40
2N4870	.50		

**INTEGRATED CIRC.**

UA703C	.40
709C OP. AMP.	.25
741C OP. AMP.	.25
7400	.15
TA7061P	3.50
TA7205P	8.00
UPC1001h2	6.00
Ne555	1.25

**RECTIFIERS**

	10	100
IN4001	.60	5.00
IN4002	.70	6.00
IN4003	.80	7.00
IN4004	.90	8.00
IN4005	1.00	9.00
IN4006	1.10	10.00
IN4007	1.20	11.00



**New-Tone Electronics**  
P.O. Box 1738 A  
Bloomfield, N.J. 07003  
Phone: (201) 748-6171  
748-6172  
748-6173

**ALL PARTS GUARANTEED**

N.J. residents add 5% sales tax. Minimum order \$5.00. All orders add \$1.00 postage. Dealers write or phone for discount prices.

**UNIVERSAL BREADBOARD**  
Silver plated copper circuit board  
1.376" x 5.116" 2 rows of 27  
holes for DIP IC's - space for  
transistors, resistors & capacitors  
Versatile and simple for bread-  
boarding IC circuits \$1.50 ea.

FREE CATALOG AVAILABLE ON REQUEST, INCLUDES  
RESISTORS +1% & +5%, TANTALUM CAPACITORS,  
POWER SUPPLY KITS, CLOCK KITS, TOOLS, RESIS-  
TOR & CAPACITOR KITS & MISCELLANEOUS DEVI-  
CES

**OCTOBER SPECIALS**

**RESISTOR KIT \$9.95**

**TTL**  
7400 .13 7451 .17 74153 .89  
7401 .16 7453 .17 74154 1.20  
7402 .15 7454 .17 74155 .97  
7403 .15 7460 .35 74156 .97  
7404 .16 7464 .35 74157 .99  
7405 .19 7465 .35 74158 1.79  
7406 .20 7470 .30 74160 1.23  
7407 .28 7472 .30 74161 .97  
7408 .18 7473 .35 74162 1.39  
7409 .19 7474 .28 74163 1.09  
7410 .16 7475 .49 74164 .99  
7411 .25 7476 .30 74165 .99  
7413 .43 7483 .68 74166 1.25  
7414 .65 7485 .88 74170 2.10  
7416 .35 7486 .40 74173 1.49  
7417 .35 7489 2.25 74174 1.23  
7420 .16 7490 4.35 74175 .97  
7422 .30 7491 .75 74176 .89  
7423 .29 7492 .48 74171 .84  
7425 .27 7493 .48 74180 .90  
7426 .26 7494 .78 74181 2.45  
7427 .29 7495 .79 74182 .79  
7430 .20 7496 .79 74184 1.90  
7432 .23 74100 .98 74185 2.20  
7437 .25 74105 .44 74187 5.75  
7438 .25 74107 .37 74190 1.15  
7440 .15 74121 .38 74191 1.25  
7441 .89 74122 .38 74192 .95  
7442 .59 74123 .65 74193 .85  
7443 .73 74125 .54 74194 1.25  
7444 .73 74126 .58 74195 .74  
7445 .73 74132 .89 74196 1.25  
7446 .81 74141 1.04 74197 .73  
7447 .79 74145 1.04 74198 1.73  
7448 .79 74150 .97 74199 1.69  
7450 .17 74151 .79 74200 5.45

**IC SOCKETS**  
**Solder Tail - low profile**  
8 pin \$ .17 24 pin .42  
14 pin .20 28 pin .59  
16 pin .22 40 pin .69  
18 pin .29

**WIRE WRAP - gold plate**  
14 pin .49

**CMOS**  
4000A .26 4018A 1.39 4066A .89  
4001A .25 4020A 1.72 4068A .44  
4002A .25 4021A 1.18 4069A .44  
4006A 1.35 4022A .94 4071A .26  
4007A .26 4023A .25 4072A .35  
4008A 1.52 4024A .89 4073A .39  
4009A .57 4025A .25 4075A .39  
4010A .54 4027A .59 4078A .39  
4011A .29 4028A .98 4082A .35  
4012A .25 4030A .44 4518A 1.56  
4013A .45 4035A 1.27 4528A 1.56  
4014A 1.27 4040A 1.39 4585A 2.10  
4015A 1.27 4042A 1.47  
4016A .48 4049A .59  
4017A 1.01 4050A .59

**2102 RAM**  
1024 bit fully decoded static RAM  
DTL/TTL compatible - 16 pin DIP 1.69

**IC BREADBOARD**  
Accommodates 5 16 pin IC's with additional  
interconnection holes. 1/16" phenolic with silver  
plated copper circuits. 2.5/16" x 6.9/16" \$1.50 ea.

**LINEAR**  
**8038 FUNCTION GENERATOR** — sine wave, voltage controlled oscillator — square, triangular output. 16 pin DIP with data \$3.95

**JUMBO LED**  
Red .12 380 .89  
Green .12 555 .39  
Yellow .12 723 .39  
370 \$ .95  
380 .89  
399 .65  
1310 1.79

**CALCULATOR CHIPS**  
5002 1.19  
5005 1.29  
5738 1.95

**MEMORIES**  
340T+5v .99  
340T+15v .99  
1103 \$ .95  
1702 8.95  
5203 8.95  
5260 .95  
5261 .95  
5262 1.19  
F93410 1.39

**DISPLAYS**  
MAN1 1.39  
NSN71L 1.19  
NSN74 1.19  
MAN8 1.39

**LOW POWER**  
74L00 .29 74L51 .29 74L90 1.40  
74L02 .29 74L55 .29 74L91 1.20  
74L03 .23 74L71 .29 74L93 1.50  
74L04 .29 74L72 .45 74L95 1.50  
74L06 .29 74L73 .56 74L98 2.25  
74L10 .29 74L74 .56 74L164 2.25  
74L20 .29 74L78 .75 74L165 2.30  
74L30 .29 74L85 1.09  
74L42 1.39 74L86 .65

**CMOS**  
74C00 .19 74C74 1.04 74C162 2.49  
74C02 .26 74C76 1.34 74C163 2.66  
74C04 .44 74C107 1.13 74C164 2.66  
74C08 .68 74C151 2.62 74C173 2.22  
74C10 .35 74C154 3.15 74C195 2.26  
74C20 .35 74C157 1.76 80C95 1.15  
74C42 1.61 74C160 2.48 80C97 .96  
74C73 1.04 74C161 2.49

**SPECIAL DEVICES**  
372 AF-IF Strip Detector DIP 2.93  
546 AM Radio Receiver Subsystem DIP .75  
1310 FM Stereo Demodulator DIP 2.90  
1496 Balanced Modulator-Demodulator .99  
1800 Stereo multiplexer DIP 2.48  
ULN2208 FM Gain Block 34db (typ) mDIP 1.18  
ULN2209 FM Gain Block 48db (typ) mDIP 1.35  
2513 Character Generator 64x8x5 DIP-24 10.20  
3046 Transistor Array DIP-14 .73

**LINEAR CIRCUITS**  
100 Pos V Reg (super) 723L TO-3 \$ .71  
301 Hi Perf Op Amp mDIP TO-5 .29  
302 Volt Followers TO-5 .53  
304 Neg V Reg TO-5 .80  
305 Pos V Reg TO-5 .80  
307 Op Amp (super) 7411 mDIP TO-5 .76  
307 Op AMP (super) 7411 mDIP TO-5 .21  
308 Micro Proc Op Amp mDIP TO-5 .89  
309 5V 1A regulator TO-3 1.35  
310 V follower Op Amp mDIP 1.07  
311 Hi perf V Comp mDIP TO-5 .95  
319 Hi Speed Dual Comp DIP 1.13  
320T Neg Reg 5, 12, 12 TO-220 1.39  
320K Neg Reg 5, 2, 12 TO-3 1.39  
322 Precision Timer DIP 1.70  
324 Quad Op Amp DIP 1.52  
339 Quad Comparator DIP 1.58  
340K Pos V Reg (5V, 6V, 8V, 12V, 15V, 18V, 24V) TO-1 1.69  
340T Pos V Reg (5V, 6V, 8V, 12V, 15V, 18V, 24V) TO-220 1.49  
370 ACC/Squelch AMPL DIP 1.20  
372 AF-IF Strip detector DIP 2.93  
373 AM/FM/5B Strip TO-5 2.42  
376 Pos V Reg mDIP .68  
380 2w Audio Amp DIP 1.30  
380-8 6w Audio Amp mDIP 1.25  
381 Lo Noise Dual preamp DIP 1.75  
382 Lo Noise Dual preamp DIP 1.75  
531 High Slew rate Op Amp 2.95  
540 Power driver TO-5 2.95  
550 Pre V Reg DIP 1.02  
555 Timer mDIP .45  
556A Dual 555 Timer DIP 1.19  
560 Phase Locked Loop DIP 3.39  
562 Phase Locked Loop DIP 3.39  
565 Phase Locked Loop DIP TO-5 1.18  
566 Function Gen mDIP TO-5 1.95  
567 Tone Decoder mDIP 1.95  
709 Operational AMP TO-5 or DIP .26  
710 Hi Speed Volt Comp DIP .35  
711 Dual Difference Compar DIP 1.26  
723 V Reg DIP 1.02  
733 Dtl, video AMPL TO-5 6.2  
739 Dual Hi Perf Op Amp DIP 1.27  
741 Comp Op Amp mDIP TO-5 .32  
747 741 Dual Op Amp DIP or TO-5 .71  
748 Freq Adj 741 mDIP .35  
1304 FM Mulps Stereo Demod DIP 1.07  
1307 FM Mulps Stereo Demod DIP .74  
1456 Op Amp mDIP 1.83  
1458 Dual Comp Op Amp mDIP 6.2  
1800 Stereo multiplexer DIP 2.48  
3900 Quad Amplifier DIP .49  
7524 Dual core memory sense Amp .70  
7525 Dual core memory sense Amp .91  
8038 Voltage contr. osc. DIP 4.16  
8864 9 DIG Led Cath Drive DIP 2.25  
25150 Dual Line Driver DIP 1.75  
25451 Dual Peripheral Driver mDIP .35  
25452 Dual Peripheral Driver mDIP .35  
25453 151 Dual Periph Driver mDIP .35  
25491 Quad Seq Driver for LED DIP .71  
25492 Hex Digit driver DIP .80

THESE DISCOUNTS APPLY TO TOTAL OF ORDER — SPECIALS INCLUDED

**10% OFF ON ORDERS OVER \$25**  
**15% OFF ON ORDERS OVER \$100**

LARGE QUANTITY PRICING AVAILABLE ON REQUEST  
PLEASE SPECIFY ITEM AND QUANTITY

**LOW POWER SCHOTTKY**  
74LS00 .36 74LS32 .38 74LS95 2.09  
74LS02 .36 74LS40 .45 74LS107 .59  
74LS04 .36 74LS42 1.40 74LS164 2.20  
74LS08 .38 74LS74 .59 74LS193 2.20  
74LS10 .36 74LS90 1.30 74LS197 2.20  
74LS20 .36 74LS93 1.30

**MEMORIES**  
1101 256 bit RAM MOS 16 pin 1.39  
1103 1024 bit RAM MOS dynamic 18 pin 1.95  
1702A 2048 bit PROM static electrically programmable UV erasable 24 pin 10.95  
2102 1024 bit RAM static 16 pin 1.95  
5203 2048 bit PROM static electrically programmable UV erasable 24 pin 10.95  
5260 1024 bit RAM MOS dynamic 16 pin 1.95  
5261 1024 bit RAM MOS dynamic 16 pin 1.95  
7489 64 bit ROM TTL 16 pin 2.25  
82523 256 PROM-SCHOTTKY 16 pin 3.69  
F93410 256 bit RAM bi-polar 16 pin 1.95  
74187 1024 bit ROM TTL 16 pin 5.75  
74200 256 bit RAM tri-state 16 pin 5.45

**CLOCK KIT**  
6 Digits (NS71L)  
MM5312 Clock Circuit  
2 PC Boards Clock & Display  
All Transistors, Resistors  
Capacitors & 3 switches with Schematic & Instructions \$14.95

4 Digits (NS74)  
MM5312 Clock Circuit  
1 PC Board  
All necessary transistors, resistors, capacitors, diodes & switches.  
With schematic & instructions \$10.95

**HIGH SPEED**  
74H00 .25 74H22 .25 74H61 .25  
74H01 .25 74H30 .25 74H62 .25  
74H04 .25 74H40 .25 74H74 .39  
74H08 .25 74H50 .25 74H101 .58  
74H10 .25 74H52 .25 74H102 .58  
74H11 .25 74H53 .25 74H103 .60  
74H20 .25 74H55 .25 74H106 .72  
74H21 .25 74H60 .25 74H108 .72

**CLOCK CHIPS**  
MM5311 6 digit multiplexed BCD, 7 seg, 12-24 Hr, 50-60 Hz — 28 pin 4.45  
MM5312 4 digit multiplexed BCD, 7 seg, lpps, 12-24 Hr, 50-60 Hz — 24 pin 3.95  
MM5314 6 digit multiplexed 12-24 Hr, 50-60 Hz 24 pin 4.45  
MM5316 4 digit, 12-24 Hr, 50-60 Hz, alarm 40 pin 4.95  
537AA 4-6 digit, 12 hour, 60 Hz snooze alarm brightness control capability, alarm tone output — 24 pin 4.95  
CT7001 6 digit, 12-24 Hr, 50-60 Hz, alarm, timer and date circuits — 28 pin 5.95

**DISCRETE LED'S**  
ME4 \$ .29  
MV50 .12  
NSL100 .12  
NSL101 .12  
NSL102 .15  
MY5020 .15  
RED .15  
GREEN .15  
AMBER .15  
CLEAR .15

**SCHOTTKY**  
74500 .38 74508 .52 74522 .38  
74502 .45 74510 .38 74532 .52  
74503 .38 74520 .38 74574 .38  
74504 .45

**CALCULATOR CHIPS**  
CT5002 12 digit, 4 function fixed decimal battery operation — 40 pin 1.95  
CT5005 12 digit, 4 function plus memory, fixed decimal — 20 pin 2.49  
MM5725 8 digit, 4 function, floating decimal 18 pin 1.98  
MM5736 6 digit, 4 function, 9V battery operation — 18 pin 2.95  
MM5738 8 digit, 5 function plus memory and constant floating decimal, 9V battery operation — 24 pin 3.95  
MM5739 9 digit, 4 function, 9V battery operation — 22 pin 3.95

**MULTIPLE DISPLAYS**  
NSN33 3 digit .12" red LED 1.79  
HP5082- 5 digit .11 red LED 3.49  
7405 3 digit .12" red LED 1.79  
HP5082- 4 digit .11 red LED 3.25  
7414 3 digit .12" red LED 1.79  
SP-425-09 9 digit .25 gas disch. 1.79

**OPTO ISOLATORS**  
MC02 Opto isolator diode 1.09  
M02 Opto isolator transistor .70

**8000 (NATIONAL)**  
8091 .61 8220 1.49 8811 .65  
8092 .61 8230 2.19 8812 1.02  
8095 1.25 8288 1.49 8822 2.19  
8121 .80 8520 1.16 8830 2.19  
8123 1.43 8552 2.19 8831 2.19  
8200 2.33 8563 6.12 8836 .29  
8214 1.49 8810 .70 8880 1.19

**8000 (SIGNETICS)**  
8263 5.79 8267 2.59

**9000**  
9002 .40 9309 .79 9601 .61  
9301 1.03 9312 .79 9602 .79

**DVM CHIP 4 1/2 DIGIT**  
MM5330 — P channel device provides all logic for 4 1/2 digit volt meter, 16 pin DIP with data \$9.95

**POCKET CALCULATOR KIT**  
5 function plus constant — addressable memory with individual recall — 8 digit display plus overflow — battery saver — uses standard or rechargeable batteries — all necessary parts in ready to assemble form — instructions included

Calc. Kit. Kit only \$ 9.95  
Batteries (alkaline, disp.) 2.00  
Adapter 3.95

**TANTALUM CAPACITORS**  
Solid dipped +20%

.1 mfd 35V \$ .25 10 mfd 16V \$ .40  
.33 mfd 35V .25 10 mfd 25V .45  
1 mfd 35V .25 15 mfd 10V .40  
2.2 mfd 20V .25 15 mfd 20V .45  
2.2 mfd 35V .30 22 mfd 16V .45  
3.3 mfd 35V .30 33 mfd 10V .40  
4.7 mfd 16V .30 47 mfd 6V .40  
6.8 mfd 6V .30 56 mfd 6V .45  
6.8 mfd 50V .40 150 mfd 15V .50

FREE CATALOG AVAILABLE ON REQUEST

Satisfaction guaranteed. Shipment will be made postage prepaid within 3 days from receipt of order. Payment may be made with personal check, charge card (include number and exp. date), or money order. Phone Orders — BofA and M/C card or C.O.D.

Add \$1.00 to cover shipping and handling if order is less than \$10.00.  
California residents add sales tax. Include shipping expense for orders shipped out of U.S. and Canada approx. 10% of order.

**INTERNATIONAL ELECTRONICS UNLIMITED**  
P.O. BOX 3036-R MONTEREY, CA. 93940 USA  
PHONE (408) 659-3171

Data included with order on request.  
Add \$3.00 ea. if item is priced below \$1.00

7400N TTL

Table listing various 7400N TTL integrated circuits with their pin counts and prices.

MANY OTHERS AVAILABLE ON REQUEST 20% Discount for 100 Combined 7400's

CMOS

Table listing various CMOS integrated circuits with their pin counts and prices.

LINEAR

Table listing various linear integrated circuits with their pin counts and prices.

74LS00 TTL

Table listing various 74LS00 TTL integrated circuits with their pin counts and prices.

DATA HANDBOOKS

7400 Pin-out & Description of 5400/7400 ICS \$2.95 CMOS Pin-out & Description of 4000 Series ICS \$2.95 Linear Pin-out & Functional Description of 7400 Series ICS \$2.95 ALL THREE HANDBOOKS \$6.95

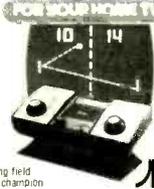
100 PER STRIP MOLEX PINS

Intended for use as an inexpensive substitute for IC sockets. Also perfect for use as board connectors and in subassemblies. SPECIAL — 100/1.49 — 1000/12.00

CONSUMER ELECTRONICS

PONG SUPER PONG SINGLE GAME \$59.95 4 GAMES IN ONE \$89.95

GAMES INCLUDED IN SUPER PONG ARE: PONG, CATCH, SUPER PONG, HANDBALL. FEATURES OF PONG AND SUPER PONG: Incremental speed on volleys increases excitement, Playing field adjusts to any size screen, Game appears in color or in black & white, depending on television set, Unmistakable 'PONG' sound accompanies each volley, Digital scoring flashes on the screen between each point, 2 player challenge on Solitaire, Hooks up simply to any model television set; the screen actually becomes the playing field, English and other techniques can be used to make any member of the family a Pong champion, Battery operated by 3 size D flashlight batteries included with the Unit.



AC Adaptor (Eliminates Batteries) \$9.95

DISCRETE LEDS SPECIAL SALE!

Table listing various discrete LEDs with their diameters and prices.

MAN 7 DISPLAY LEDS SUPER SAVINGS! \$99

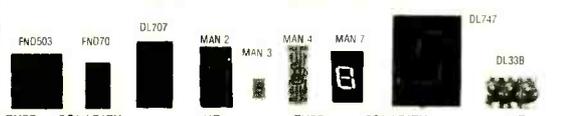


Table listing various display LEDs with their types, polarities, and prices.

IC SOLDERTAIL — LOW PROFILE (TIN) SOCKETS

Table listing various IC solder tail sockets with their pin counts and prices.

WIRE WRAP SOCKETS (GOLD) LEVEL #3

Table listing various wire wrap sockets with their pin counts and prices.

50 PCS. RESISTOR ASSORTMENTS \$1.75 PER ASST.

Table listing various resistor assortments with their values and prices.

SINGLE TURN 1/4" CERMET POTENTIOMETER \$8.99

Resistance Tolerance — ±20%, High Power — 0.5 Watt at 70°C, Wide Operating Temp. Range — 55°C to +125°C, STANDARD RESISTANCE VALUES, 50Ω 100Ω 500Ω 1K 2K 5K 10K 20K 50K 100K 200K 500K 1 MEG

\*Astrisk Denotes Items On Special For This Month\* Satisfaction Guaranteed. \$5.00 Min. Order. U.S. Funds. California Residents — Add 6% Sales Tax — Data Sheets 25c each Send a 13c Stamp (postage) for a FREE 1976 Catalog

JAMES 1021 HOWARD AVE., SAN CARLOS, CA. 94070 PHONE ORDERS — (415) 592-8097

MINIATURE TOGGLE switch with ON/OFF/ON and ON/NOISE/ON positions.

PB-123 \$1.75 and PB-126 \$1.75 push buttons.

THUMBWHEEL SWITCHES with various configurations and prices.

CLIPLITE!! 4/ NEW LED MOUNTING SYSTEM \$1.00

CLIPLITE mounts from the front of the Panel in a .250 hole on 3/8" centers. Panel thickness from 1/16" to 1/8". CLIPLITE is to be used with XC556 LED only. Specify red, green, amber or yellow CLIPLITES when ordering.

ZENERS—DIODES—RECTIFIERS table listing various diodes with their types, voltages, and prices.

SCR AND FW BRIDGE RECTIFIERS table listing various rectifiers with their types and prices.

TRANSISTORS table listing various transistors with their types and prices.

CAPACITOR table listing various capacitors with their values and prices.

CORNER table listing various corner capacitors with their values and prices.

MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS table listing various capacitors with their values and prices.



# Olson electronics

Parts and Accessories



UNDER DASH STEREO/CB  
**SLIDE MOUNT**



AU-344

**2.99**

IN-DASH  
**AUTO STEREO**

with AM FM Radio  
Your Choice  
**CASSETTE**  
8 TRACK



AU-464 - AU-527

**\$49**

**8" OLSON 3-WAY SPEAKER-SYSTEM**



SP-209

**\$24**

**MULTIMETER**  
1000 OHMS/VOLT  
Great for Hobbyists



TE-184

**\$5.99**

**PARTS & COMPONENTS**

	REG.	SALE
100 Ceramic Capacitors, values clearly marked	CC-210	1.29 80
50 Asst. Electrolytic Capacitors, Axial/Radial	CC-407	5.00 2.00
100 Asstd. Carbon Resistors, 1/4-1/2 Watt Sizes	RR-D77	1.79 1.00
5 Asstd. SCR's, 15 V. and Up, 100 MA to 1.6 AMP	TR-298	1.79 1.00
500 MW Zener Diodes, 4.3-6.3-9.1-12 & 15 Volts	DI-052	1.00 .50
3 Unijunction Transistors, 40 V. 375 MW. 4 DN/S	TR-441	1.29 .50
L.E.D. Pkg. of 5 Red, 2 Volt - 5 MA.	PL-233	1.19 .60
Ultra-Mini L.E.D. Pkg. of 5 Red, 2 V. 5 MA	PL-289	1.29 .70
Tl Calculator Key Board, 20 Keys	XM-523	5.00 1.60
3 1/2 Digit Liquid Crystal Display	XM-371	10.00 3.00
Darlington Amp. Transistor Kit, 6 Transistors	TR-507	2.00 1.50
Photo Transistor, 5 Pieces-Epoxy Type	TR-502	1.00 .60
6 Amp Full Wave Bridge Rectifier 50 PIV	DI-057	1.20 .80
6 Amp Full Wave Bridge Rectifier 400 PIV	DI-058	1.90 1.00
PNP Transistor Assortment Pkg. of 10	TR-445	1.00 .60
NPN Transistor Assortment Pkg. of 10	TR-446	1.00 .60
7-Segment L.E.D. Display 3 In. Green	XM-341	2.69 1.00
7-Segment L.E.D. Display 3 In. Red	XM-370	2.00 1.00
7-Segment L.E.D. Display 3 In. Yellow	XM-342	2.49 1.00

**TOOLS - SPECIAL AND PRACTICAL**

Wire Wrap Tool, 30 Ga Wire on .025 Post	TL-845	2.60 2.00
IC Insertion/Extraction Tool	TL-846	1.25 1.00
IC Plug-in Test Adapter	TE-396	2.60 2.00
12 Volt DC Soldering Iron, Pencil Tip	TL-793	4.00 3.00
117 Volt AC Soldering Iron, Pencil Tip	TL-448	3.29 2.50
Tuner/Contact Cleaner, 6 Oz. Can	TL-459	1.49 .80
Dymo Label Maker, Uses 3/8 In. Tape	TL-752	1.89 .90
Double Face Foam Tape 3/4 x 52 In.	TA-903	1.00 .80

**RECORDING TAPE AND ACCESSORIES**

8 Track, 40 Min. Blank Tape	TA-854	1.49 1.00
8 Track, 80 Min. Blank Tape	TA-855	1.79 1.20
8 Track, 40 Min. Blank Tape	TA-907	.69 .50
60 Min. Cassette, Pkg. of 3	TA-879	1.49 .80
10 In. Reel 3600 Ft. 1 Mil Mylar Tape	TA-608	2.99 2.00
8 Track Head Demagnetizer, 12 Volt DC	HF-160	3.00 1.30

**FREE**  
8 Olson  
Catalogs

NEXT 8  
ISSUES  
SENT TO  
YOU FREE

Olson Electronics, 250 S. Forge St.,  
Dept. LQ, Akron, Ohio 44327

Please send me  Olson Catalog

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_

STATE \_\_\_\_\_ ZIP \_\_\_\_\_

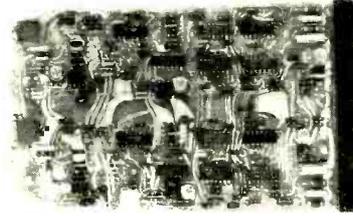
CIRCLE 17 ON FREE INFORMATION CARD



# DELTA ELECTRONICS

P.O. BOX 2, AMESBURY, MASS. 01913

## SOPHISTICATED LINEAR PARTS BOARD



This dual channel wide-band amplifier is loaded with late model parts. It has 2 ea, 733 differential video amps, LM 301 op amps, MC1414 dual differential comparators (dual 710s), CA3083 NPN DIP transistor arrays, MD2219 dual high speed NPN transistors, 9624 dual interface converters, 74123 dual one shots, and (4) 7400s. Also (6) trim pots, caps, transistors, and many precision resistors and 1/4 watt resistors. One of the best sources of parts we have ever offered.

STOCK NO. R5442 1 lb. \$3.50 each, 2/6.00

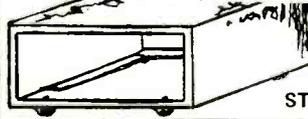
## PUSH-TO-TALK HANDSET

Update your CB set or other mobile communications with this push-to-talk handset made by STROMBERG-CARLSON. It has a low impedance carbon mike (might require impedance matching) and a push switch in the handle. The 1 foot coiled cord stretches to 5 feet. Also useful for intercoms, etc. Black. Shipping weight 2 lbs. NEW.



STOCK NO. R5193 \$9.95 each, 2/18.00

## VINAL CLAD WALNUT CABINET



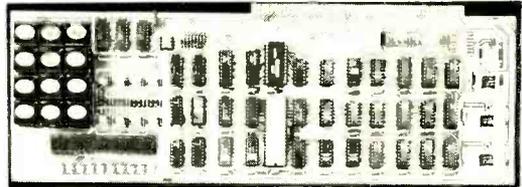
Adds the ideal finishing touch to your home brew projects. 8 3/4" wide x 4 1/4" high x 10 3/4" deep. 3/8" thick. With rubber feet. 2 lbs.

STOCK NO. R7129 \$5.95 ea, 2/10

Send for latest free catalog. Minimum order \$5, phone orders welcome: (617) 388-4705. Include sufficient postage; excess will be refunded. BANKAMERICARD & MASTERCHARGE welcome, ALL numbers needed for processing. Minimum charge \$15.

CIRCLE 53 ON FREE INFORMATION CARD

# 8080 microprocessor board \$139.95



This board is 5" x 15" --- the same size as an Altair 8800 or IMSAI front panel. Add it to your machine, and you upgrade both the front panel and CPU board. Or build your own computer system around it, using Altair/IMSAI compatible peripherals.

This kit contains some of the most advanced low power Schottky devices available and the CPU meets 8080A electrical specs. A 12 key keyboard and ten 7 segment displays make for easy program loading and debugging. Outputs to the data buss drive 30 TTL loads; inputs are buffered by LP Schottky or PNP input TTL devices. Perhaps most important of all, the board contains 256 bytes of ROM and 256 bytes of RAM to implement the Front Panel Program. You may start, stop, or step any program running in external memory. While halted memory locations and registers may be written into or altered. On board regulators accept the three standard voltages present in Altair/IMSAI computers, or add your own supply for stand alone systems.

Want to know more about this and other products? Request our flyer. ORDERS: We accept BAC® and Mastercharge®, and pay postage. Cal add tax. No COD.

**MORROW'S**  
Micro-STUFF  
BOX 6194  
ALBANY,  
CA 94706

CIRCLE 25 ON FREE INFORMATION CARD

## COMPLETE ALARM CLOCK

- \* 4 Digits 0.5" LED with brightness control
- \* 12 Hour display with AM/PM indication
- \* True 24 hour alarm with repeatable snooze
- \* Power failure indication for power interrupt



MODEL EC 400  
(Not A Kit)  
Only \$22.50  
ON SALE \$17.50 ea.

## NEW CLOCK KITS!



MODEL OC1032  
JUMBO DIGITS  
ALARM CLOCK  
1.2" Bright Yellow  
Color Readouts

Features: 12/24 Hour Display, 24 Hour Alarm Set, 10 Min Snooze Switch, AM/PM Indicator  
Kit Includes: Woodlike Color Plastic Case, 4 Digit 1.2" Neon Display with AM/PM, TMS 3834 Alarm Chip, 2 pcs. double sided PC Boards, 16 transistors, all other components, Transformer and speaker

**SPECIAL \$35.90**



MODEL OC1030  
4 DIGIT  
ALARM CLOCK KIT  
0.5" Green Color  
Readouts

Features: 12/24 Hour Displays, 24 Hour Alarm Set, 10 Min Snooze Switch, AM/PM Display.  
Kit Includes: Orange Color Plastic Case, 0.5" LD8132 Green Color Readouts PC boards with transformer, all electronic parts with speaker.

**Only \$28.50**

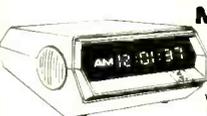
## THE MOST POPULAR



MM5314 KIT

WITH A NEW CASE!!  
Features: 12/24 Hour Display  
50/60 HZ Input 6 Digits Readout  
Kit Includes: Grey Color Plastic Case MM5314 Clock Chip PC Boards and Transformer, 6 Green Color 0.3" Tube Readouts, All other transistor Drivers and other Components.

**Special Only \$19.95 ea.**



MODEL CT7001

Drive 6  
Fairchild FND  
0.5" Red LED  
with MONTH & DATE  
50/60HZ and ALARM

(without case) **Only \$28.50 ea.**

## COMPUTER KEYBOARDS



Standard Teletype Keyboards with gold plated contact switches. All switches are independent and allow you to connect into any form of output.

**Only \$22.50**



5W AUDIO AMP KIT

USE 2 LM380  
with Volume Control  
POWER SUPPLY 6VDC  
**only \$5.00 ea.**

## VOLTAGE REGULATORS

ALL POSITIVE OUTPUT

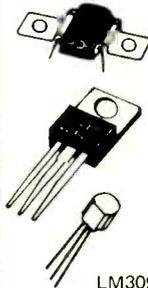
FAIRCHILD 78 MG

Adjustable Volt Regulators  
500MA 5V 30V Output  
with data ONLY \$1.60 ea.  
LM340T 1 amp Output  
5V, 6V, 9V, 12V, 15V, 24V  
Positive only \$1.10 ea.

MINI SIZE REGULATOR  
in TO-92 package

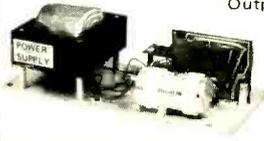
78L05, 78L012 by Fairchild  
Low Power 500MA Output  
Only \$0.80 ea.

LM309K 5V 1amp TO-3 \$1.00 ea.



## 3 AMP POWER SUPPLY

UA723 REGULATED  
Output 5V and 12V  
Input 110AC



**only \$19.50**

\*Postage  
for this item  
\$2.50



12 VDC Relay

SPDT 4 amp  
\$1.25 ea.

MINI SIZE  
12V RELAY  
DTDT 500  
\$1.40 ea.



6V 6AMP YUASA  
Wet Rechargeable Battery

BRAND NEW \$7.50 ea.  
\* Add 50c Postage for  
This Item

## AC ADAPTERS

110V AC Input  
4.5V 100MA, 6V 100MA  
9V 100MA, 12V 100MA  
\$2.85 each  
12V 150MA AC output: \$2.00 ea.



## TRANSFORMERS

110V input  
12 0-12V lamp \$2.25 ea  
12V CT 500MA  
with one group 165V \$1.50 ea.  
0.3 12-24V 500MA \$2.75 ea.



## NI-CD FAST CHARGE BATTERIES

Rechargeable AA Size  
BY SANYO  
ALL BRAND NEW  
\$1.60 each 4 for \$6.00



## AUTO ALARM KIT



The Crimefighter Auto Alarm is an electronic, self controlled auto protection system, normally mounted within the glove box of an automobile.

Two minutes after turning off the ignition, the alarm automatically turns itself "on." When the auto is re-entered, the horn will sound after a 10-45 second entry delay. The automobile owner, by inserting the ignition key, will activate the alarm. Once activated, the alarm will sound for two minutes before automatically turning off. The alarm then resets and is ready to again protect the vehicle from unwanted entry.

FEATURES: Simple installation 5 wires. Automatically turns on when auto is parked. Adjustable entry time. Extended exit time to allow for unrush exit from vehicle. Numerous applications include: protection of boats, campers, trailers, motorcycles, trucks. Cannot be deactivated by "hot wiring" an auto. Cannot be turned off without ignition key. Negative ground only.  
ONLY \$10.00 per kit Completed Unit \$16.00

## LED READOUTS



Fairchild FSC 8000  
0.8" Red LED 3 1/2 Digits  
with AM/PM  
Direct Drive by MM 5316 or Fairchild 3817  
\$10.50 ea.

## JUMBO LED

Fairchild FND 800  
0.8" Common Cathode  
Red Color  
ONLY \$3.50 ea.

MAN 74	Red	\$1.00
MAN 84	Yellow	\$1.50
HP 0.3"	Red	\$1.20
DL 747	RZ-D	\$2.50
DL 727	Double Digit	\$2.50
DL 707	0.3" Red	\$1.30
FND 70	0.25" Red	\$0.60
FND 503	0.5" Red	\$1.60
FLV 50	Submini Red	\$0.15 ea.
FLV 209	Mini Red	\$0.15 ea.
	Jumbo Red	\$0.15 ea.
	Jumbo Green	\$0.25 ea.
	Jumbo Orange	\$0.25 ea.

## 50 UA PANEL METER

First designed for metal Finder Scaled from 0-10 but can be erased and your own scale put on top. Brand new in box.  
Only \$3.80 ea.

## 150UA METER

only \$1.50 ea.

## QUAD VOLUME CONTROL

(JOY STICK)  
4 100K Volume pot in one unit. Low resistance proportional to the angle of the stick. Perfect for electronic games or model remote control.  
only \$5.50

## COMPUTER GRADE CAPACITOR

15500 MFD  
75V-DC \$5.95 ea.  
6000 MFD  
75V-DC \$4.00 ea.  
Postage for above items \$1.50 ea.

## ELECTRONIC SWITCH KIT

CONDENSER TYPE



Touch on Touch Off  
use 7473 I.C.  
and 6V relay  
\$5.50 each

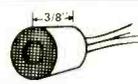
## FM WIRELESS MIC KIT



Transmit range up to 500ft.  
Easy to assemble  
\$4.50 each

## Sub-Mini Size Condenser Microphone

\$2.50 each



## ELECTRONIC ORGAN



KEYBOARD  
3 Octaves Full Size  
Limited Quantity  
\$33.00 each

## SAE DIP SWITCHES



Part No. 1004 692 4XSPST SW  
1008 692 8XSPST SW  
4 Toggle SPST Switches on a Mini-DIP (8 pins) Only \$1.50 ea.  
8 Toggle SPST Switches on a DIP (16 pins) Only \$2.60 ea.

## SUBMINIATURES TOGGLE SWITCHES

SPDT On-None-On \$1.30 ea.  
DPDT On-None-On \$1.50 ea.

## ECCO BCD THUMBWHEEL SWITCHES

8 positions \$1.25 ea.  
10 positions \$2.15 ea.  
12 positions \$2.50 ea.

## COLORFUL SUB MINI PUSH BUTTON SWITCH

Non Open Contacts  
Color Red, Green, Yellow, Black  
4 for \$1.00

## QUARTZ CRYSTALS

1MHz Computer Crystals \$4.25 ea.  
3.58 MHz Color TV Crystals \$1.25 ea.  
Use with Nation MM 5369 to make a perfect time base for clock.

**NEW!**  
NATIONAL MM 5369 17-STAGE PROGRAMMABLE OSC/DIVIDER generate A 60 Hz reference frequency with a 3.58 MHz color TV XTAL in Mini-DIP Package  
ONLY \$2.25 each

**THUMBWHEEL TRIM POTS**  
VALVE: 300R, 2K, 2.5K, 5K, 10K, 12K, 50K, 1M  
Special Offer: 5 for \$1.00

**Big Sale On Computer I.C.**  
INTEL 8300B CPU \$9.95 ea.  
INTEL 1702A ERASABLE PROM \$9.50 ea.  
NATIONAL 2102 1K RAM \$1.99 ea.  
TI TMS4030 4K RAM \$5.50 ea.  
Limited Quantity of the Above Parts

MINIMUM ORDER \$10.00. California residents add 6% sales and 1.50 to cover postage and handling. Out-of-state and overseas countries add \$2.50.

SEND CHECK OR MONEY ORDER TO:

# FORMULA INTERNATIONAL INC.

12603 CRENSHAW BOULEVARD • HAWTHORNE, CALIFORNIA 90250

For more information please call (213) 679-5162

STORE HOURS 10-7 Monday - Saturday



# LIVE IN THE WORLD OF TOMORROW... TODAY!

And our FREE 164 PAGE CATALOG is packed with exciting and unusual values in electronic, hobby and science items — plus 4,500 finds for fun, study or profit... for every member of the family

## A BETTER LIFE STARTS HERE

### SAVE 50%!

#### 8 X 20 MONOCULAR

Fantastic bargain! Top quality Spy Scope, a \$30 value, now offered at \$14.95! Our special purchase saves you 50% and you get 100% coated optics: 393 ft. field of view. Only 2 oz.—stores in pocket, purse, glove compartment. Fits in your palm—peer into hard-to-see places without letting subject know you're spying. Great for birders and race fans; incl. neck strap, leatherette 3 1/2 x 1 1/2 x 2" case. Beautiful brushed metal finish. Buy two—one for a gift!



Stock No. 1568EH ..... \$14.95 Ppd.

#### SEE MUSIC IN PULSATING COLOR

New 3-Channel Color Organ adds to music listening pleasure, lets you modulate 3 independent strings of colored lamps with intensity of your music to create an audio "light show." They flash, vary in brightness related to music's rhythm, pitch, volume—pulsating lighting performance to music! Fully assembled & priced half that of others, the Edmund Sound To Light Control is a terrific value. Plug in, turn on!



No. 42,309 EH (ASSEMBLED) ..... \$17.95 Ppd.  
No. 42,336 EH (UNASSEMBLED) ..... \$13.95 Ppd.

#### AN ALPHA MONITOR FOR \$34.95!

Yes, because you built it! Use your ability to tune in your brainwaves, an aid to relaxation, concentration. Kit incl. everything you need (except 9v trans. batt.) to own a portable self-cont. BIOFEEDBACK unit for a pittance: steth. earphones, electrode headband, solid-state circuitry; 5 microvolt sensitivity, more! Compl. assembly instructions & op. manual. With basic electronics knowledge, you can do it!



No. 61,069 EH (KIT) ..... \$34.95 Ppd.  
No. 71,809 EH (FULLY ASSEMBLED) ..... \$55.00 Ppd.

#### LOW COST DIGITAL THERMOMETER

Terrific buy! Pocket-size (just 4x2x1 1/2"; a mere 8 oz.) and gives you a fantastic -1% accurate temperature reading in big, bright LED display! Just press the "on" switch and, within seconds, read temperature error free, ranging from -40 to 200 F. Handy digital thermometer comes with penetration/surface probe. Is precision built and solid state—no moving parts to wear out. Powered by 3 AA (1 1/2v) alk. batts. (incl). Easy, accurate, fast way to measure temperature!



Stock No. 61,118EH ..... \$190.00 Ppd.

#### WORLD'S SMALLEST HI-FI (6 1/2 x 4 1/2 x 6")



Now, the gorgeous sound of true hi-fi w/ a receiver & sep. 8 ohm speaker (6 1/2 x 1 x 6") small enough, and priced low enough, to go in your bedroom, den, kitchen, office, shop! Great for doctors, dentists. Its wide-range rich sound compares favorably to any stereo at its price, but it's not—it's a monophonic FM radio into which you can plug a cassette, etc. (record, play back)! Hi-fi system has Baxandall type controls (ab. 12 dB boost or cut @ 100 Hz & 10 KHz). Beautiful!

No. 72,262EH... (120V AC)..... \$127.50 Ppd.

#### LOW COST INFRA-RED VIEWER



For Infra-red crime detection surveillance, security system alignment, I.R. detection, laser checking, nite wildlife study, any work req. I.R. detection & conv. to visible spectrum. Self cont. scope w/ everything incl. I.R. light source. 6v or 12v power, 6032 I.R. converter tube, f/3.5 objective lens, adjust. triplet eyepiece. Provides 1.6X, focuses from 10' to infinity.

No. 1659EH (11x14 1/4 x 3") ..... \$285.00 Ppd.  
WITHOUT LIGHT SOURCE  
No. 1663EH ..... \$225.00 Ppd.

#### PRO ELECTRONIC SOUND CATCHER



Parabolic mike w/18 3/4" transparent reflecting shield & 2 I.C.'s in amplifier magnifies signals 100x that of omni-direction mikes. Catch sounds never before heard! Highest signal to noise ratio poss. Earphones, tape recorder output, tripod socket; req. two 9V trans. batt. (not incl.).

No. 1649EH (5 1/2 LB.) ..... \$299.00 Ppd.  
LOW COST MODEL: NO EARPHONES, ELECTR. CIRC.  
No. 1665EH ..... \$149.95 Ppd.  
LOWER SENSITIVITY ECON. MOD. W/O ELECTR.  
No. 80,242EH ..... \$89.50 Ppd.

#### LEARN HOW TO RELAX BETTER!



New inexpensive biofeedback monitoring device helps you learn tension reduction techniques w/o electrode headbands, messy creams. Designed by clinical psychologists working in the stress reduction field. This handsome Executive Galvanic Skin Response

Meter features solid-state electronics for great sensitivity, compactness, dependability. Walnut & gold-plated brass case. Uses 9v batt. (incl). Learn to take a 10-minute "vacation" at your desk!  
No. 42,393EH ..... (2 1/2 x 4 x 1 1/8") ..... \$55.00 Ppd.

#### KNOW YOUR ALPHA FROM THETA!



For greater relaxation, concentration, monitor your Alpha/Theta brainwaves w/ audible or visible signal on Biosone II. Has 3 feedback modes, outputs to monitor logic signal, filter sel. feedback, broad sensitivity control; other professional feats. of \$200-up units. Easily operated 4-lb. portable has total brainwave monitoring capability! Req. 2 9v tr. batteries.

No. 1668EH (9 1/2 x 5 3/8 x 4 1/4") ..... \$149.95 Ppd.  
LOW COST STARTERS' UNIT (PORTABLE)  
No. 71,809EH (4 1/2 x 2 3/4 x 4 1/4") ..... \$ 55.00 Ppd.

## MAIL COUPON FOR GIANT FREE CATALOG!

164 PAGES • MORE THAN 4500 UNUSUAL BARGAINS

Completely new 1977 edition. New items, categories, illustrations. Dozens of electrical and electromagnetic parts, accessories. Enormous selection of Astronomical Telescopes. Unique lighting and ecological items. Microscopes, Binoculars, Magnifiers, Magnets, Lenses, Prisms. Hard-to-get surplus bargains. Ingenious scientific tools. 1000's of components.

EDMUND SCIENTIFIC CO.  
300 Edscorp Building, Barrington, N.J. 08007  
Please rush Free Giant Catalog "EH".

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_



## COMPLETE AND MAIL WITH CHECK, M. O. OR CHARGE NO.

EDMUND SCIENTIFIC CO.

300 Edscorp Building, Barrington, N.J. 08007

(609) 547-3488

How Many Stock No.

PLEASE SEND GIANT FREE CATALOG "EH"

Charge my  American Exp  BankAmericard  Master Chg

Interbank No. \_\_\_\_\_

My Card No. Is \_\_\_\_\_

Card Expiration Date \_\_\_\_\_

30-DAY MONEY-BACK GUARANTEE.  
You must be satisfied or return any purchase in 30 days for full refund.

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

Add Handling Charge

\$1.00

I enclose

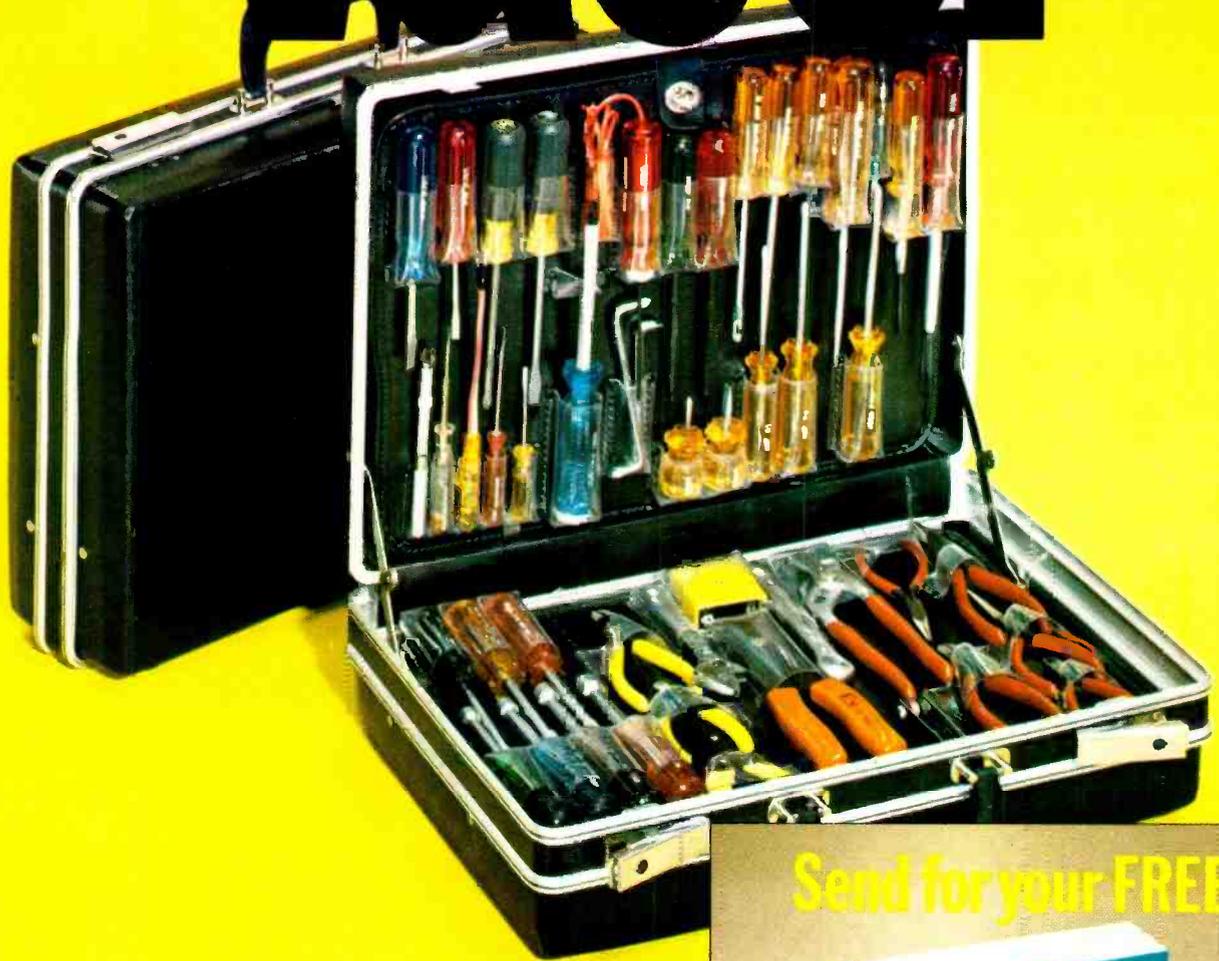
check  money order for TOTAL \$ \_\_\_\_\_

Signature \_\_\_\_\_

State \_\_\_\_\_

Zip \_\_\_\_\_

# Vaco.



## Super Case

Vaco means value and variety.

Like our Super Case. A great value with great variety. 48 professional problem-solving tools from screwdrivers and nutdrivers to pliers, wrenches, crimping tools, and more! All right at hand. And all unconditionally guaranteed.

You'll find the Super Case and all the other fine Vaco tools in our exciting new 64-page Bicentennial Catalog. FREE for the asking! Just write:

Vaco Products Co., 510 N. Dearborn St., Chicago, Illinois 60610.

Send for your FREE



64 colorful pages with the complete Vaco selection.

1976 VACO catalog!

CIRCLE 78 ON FREE INFORMATION CARD

[www.americanradiohistory.com](http://www.americanradiohistory.com)

**Experience is the best teacher.** You might settle for any CB first time around. Understandably. A lot of people think they're all pretty much alike. But you'll soon discover that, like everything else, there are exceptions.

**Ask the pros.** America's long distance truckers. These guys talk CB day in and day out. And they demand the best. That's why truckers refer to the Cobra 29 as "The Diesel Mobile."

**Listen to Cobra.** You'll hear a big difference. Because the Cobra 29 gives you features which assure crystal clear reception. Like switchable noise limiting and blanking, to cut out practically all pulse and ignition interference. Add squelch control and RF gain and you've got exceptional—adjustable—receiver clarity. Even in the heaviest CB traffic. You also get Delta Tuning which makes up for the other guy, because even off-frequency transmitters are pulled in. Perfectly.

**Talk to Cobra.** And you know you're punching through. One glance at the

29's over-sized illuminated meter tells you just how much power you're punching out and pulling in. For voice modulation the DynaMike delivers at 100%. Same way with power: The 29 transmits at maximum power levels.

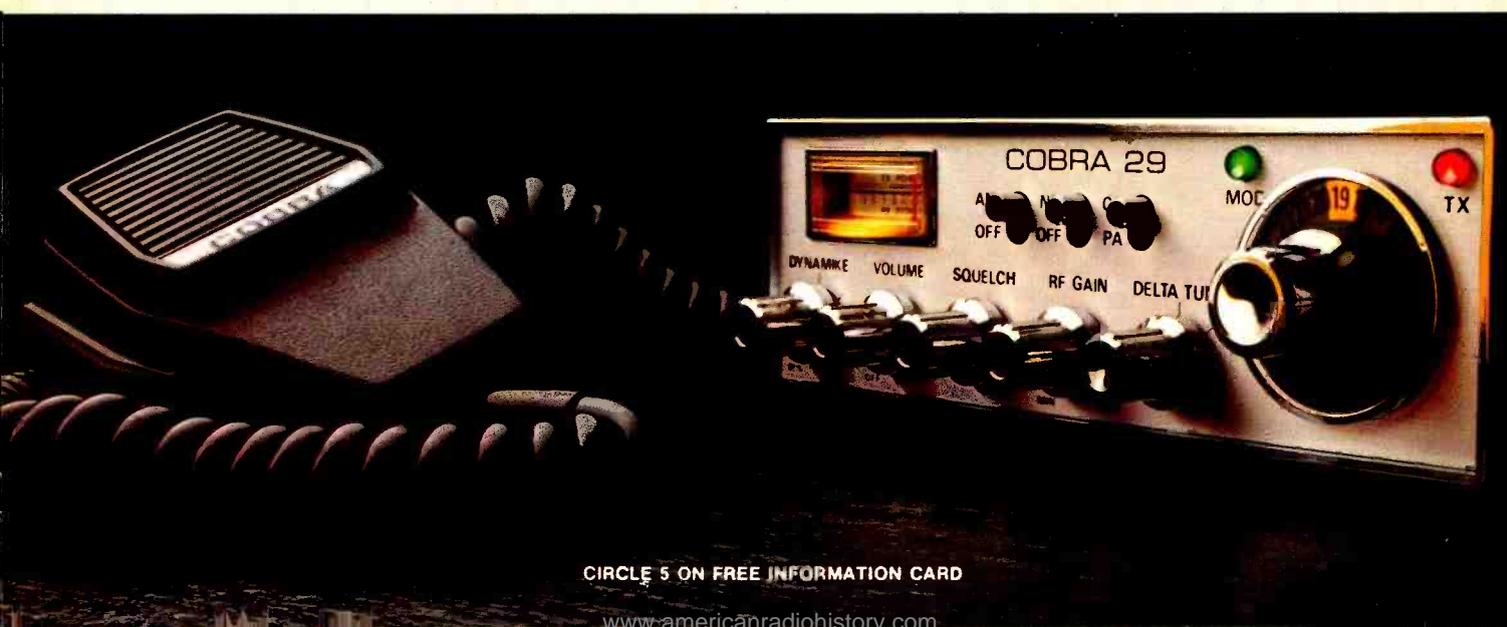
**Sooner or later you'll get a Cobra.** And you'll get engineering and craftsmanship second to none. Performance that will make your first CB seem obsolete. Reliability and durability that have set standards for the industry. Above all, you'll get power. The power to punch through loud and clear like nothing else. Because when it comes to CB radio, nothing punches through loud and clear like a Cobra.



**Punches through loud and clear.**

Cobra Communications Products  
DYNASCAN CORPORATION  
6460 W. Cortland St., Chicago, Illinois 60635

# IF YOUR FIRST CB ISN'T A COBRA YOUR SECOND ONE WILL BE.



CIRCLE 5 ON FREE INFORMATION CARD

[www.americanradiohistory.com](http://www.americanradiohistory.com)