

# Radio-Electronics

FOR MEN WITH IDEAS IN ELECTRONICS

## SPECIAL ISSUE — 4 CHANNEL STEREO

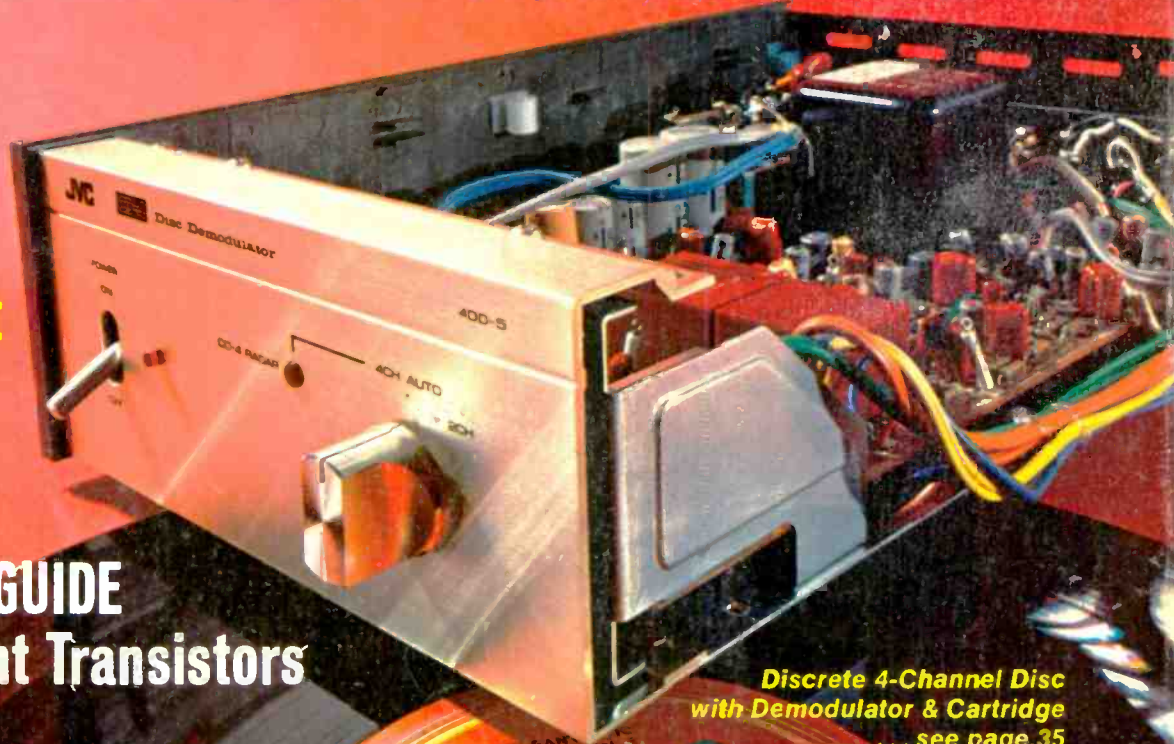
**BUILD A 4-CHANNEL AMPLIFIER**  
60 Watts rms Per Channel

**OFF-BEAT SPEAKER SYSTEMS**  
For The Rear Channels

**4-CHANNEL ON THE GO**  
New Tape Gear For Cars

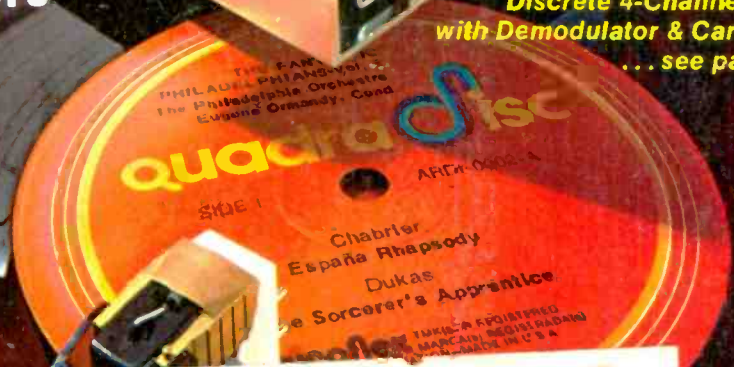
**4-CHANNEL MATRIX**  
How Good Is It?

**TAPE BIAS ADJUSTMENTS**  
How They Affect Recording



**SUBSTITUTION GUIDE**  
For Replacement Transistors

*Discrete 4-Channel Disc with Demodulator & Cartridge ... see page 35*



**PLUS**  
Lou Garner's  
State-Of Solid-State  
Jack Darr's Service Clinic  
Step-By-Step Troubleshooting

302972 DRK 0028A095 JUN73 0 A  
L DARKNELL JR  
20 ARDEN CT  
REDWOOD CITY CA 94061

GERNSBACK  
PUBLICATION

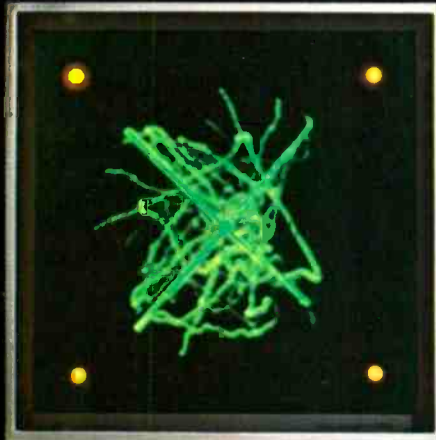


# Do you know what 4-channel sound looks like?

If you don't know, then you're probably missing something. Because it's easier to adjust your 4-channel system when you see where all that sound is coming from. That's why Panasonic has made a 4-channel audio scope. Model SH-3433. With it you'll be able to see if you're getting the most out of your music. Whether it happens to be stereo. Matrix. Or discrete 4-channel. In either 8-track tapes or Compatible Discrete 4-channel (CD-4) records. Like RCA Quadradiscs.

The SH-3433 lets you see the strength and phase relationship of all 4 channels, at one time. You can look at two channels, if you're listening to stereo. Or one. Turn the Wave Form selector to the one channel you want to see. The screen will show it.

The audio scope has controls for position, balance, focus and brightness. A gain control to



change the size of the wave form. Plus a Scope Mode switch for either matrix or discrete sound.

The back panel has jacks for most accessories. Stereo or 4-channel. Including two for an FM tuner. So you can monitor FM stereo wave forms and detect possible FM multipath problems. And if you're using 2 stereo amplifiers to get 4-channel sound, you can see if the front signals and

back signals are in phase. With our special Rear Phase switch.

Of course, you need more than an audio scope to get 4-channel sound. So look, and listen, to our other discrete 4-channel equipment. Like our Model SA-6800X receiver. It has Acoustic Field Dimension, so you can adjust the speaker separation electronically. You move the sound to fit the size of the room. Without physically moving the speakers. It also has a phase shifter for the various matrix systems. 300 watts of power (IHF). Plus a remote balance control.

You can see our 4-channel audio scope, receivers and other components at your franchised Panasonic Hi-Fi dealer. But before you settle back and listen, take a look. Because in 4-channel sound, seeing is believing.

FOR YOUR NEAREST FRANCHISED PANASONIC HI-FI DEALER, CALL TOLL FREE 800 243-6300. IN CONN., 1-800 882-6500.

## Panasonic® Hi Fi 4-Channel Audio Scope



SH-3433

SA-6800X

# Take advantage of this U.S. Government booklet and get started in a big-income career.

"...you no longer need four years of college to start out on a scientific or technical career.

"You can break into any field—from medicine to computers to engineering to the space program—with only a year or two of education. Just become a technician."

U.S. OFFICE OF EDUCATION

**H**ow far can you go without four years of college? Here's what the U.S. Government says about it in a booklet published by the U.S. Office of Education:

"A lot of people think that careers are meant for college graduates—jobs are for everybody else.

"Ten years ago, they may have had a point.

"But something's happened recently to change all that. A revolution in science and technology...

"You no longer need four years of college to start out on a scientific or technical career.

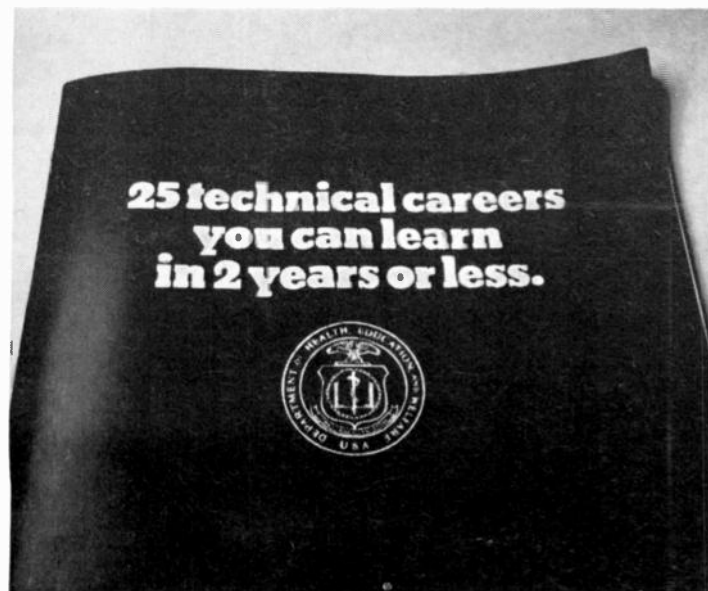
"You can break into any field—from medicine to computers to engineering to the space program—with only a year or two of education. Just become a technician."

## Free Guidance Materials

To help you select the technical career field that's right for you, we've listed opportunities in the special coupon, at right. And you can find out what you should know about the field you like best by simply checking off your choice and mailing the coupon today.

## Free Guidance Booklet

By return mail, you will receive a free ICS Career Guidance Booklet that describes the opportunities, income and job security you might expect in your newly-chosen field. It will also explain how ICS can help you get the training you need to break into this



More than 8,500,000 men and women have turned to ICS for career training since 1890. Some 2,000 American firms and government agencies are using ICS training programs to upgrade their employees. (Among these firms are such names as Ford, U.S. Steel, Chrysler, Mobil, 3M Company, Alcoa, Pan Am, GE, Motorola and RCA.)

ICS career training is approved for veterans training, and is Accredited by the Accrediting Commission of the National Home Study Council. Just mail the coupon for your free guidance materials to: ICS, Scranton, Pa. 18515.

new career field...right in your home... during your spare time...without losing a single day's pay from your present job...and without ever setting foot in a classroom.

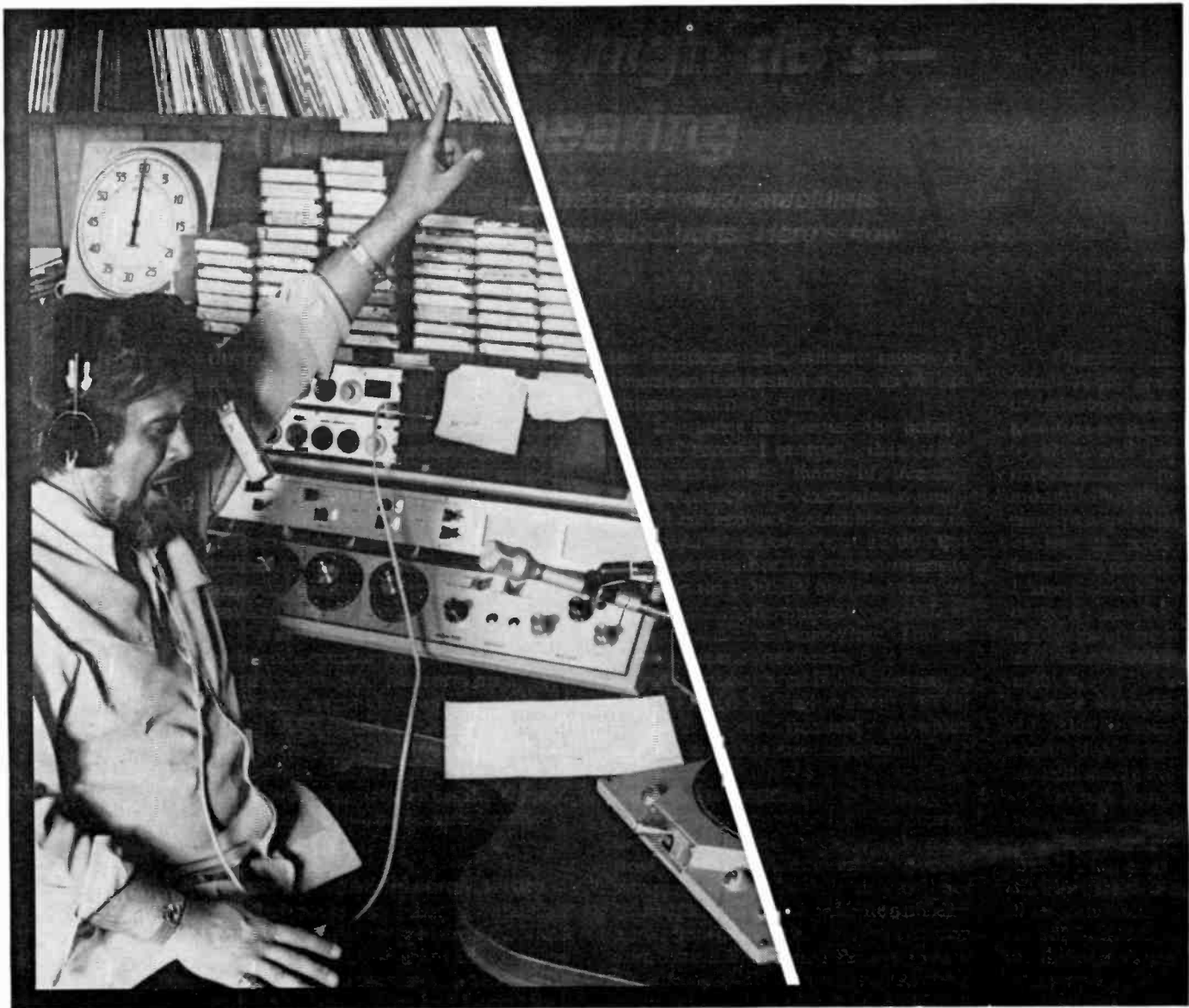
## Free "Demonstration Lesson"

In addition, you'll receive a free "Demonstration Lesson" that lets you see for yourself why picking up the job skills you need—the ICS way—may be easier than you think.

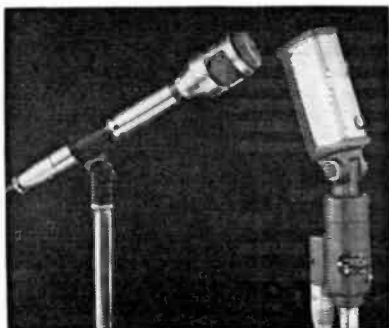


<b>ICS</b> International Correspondence Schools Scranton, Pennsylvania 18515		RA 712N	
Please send me free ICS Career Guidance Booklet and a free "Demonstration Lesson" for the field I have checked below. I understand I am under no obligation.			
<input type="checkbox"/> Architecture	<input type="checkbox"/> Communications, Broadcasting Technician	<input type="checkbox"/> FCC Licensing (Electronics)	<input type="checkbox"/> TV Servicing & Repair
<input type="checkbox"/> Air Conditioning, Refrigeration & Heating	<input type="checkbox"/> Diesel, Gas Mechanic	<input type="checkbox"/> Check here for special information, if age 16 or under	
<input type="checkbox"/> Automotive Mechanics	<input type="checkbox"/> Drafting (Mechanical)	<input type="checkbox"/> Surveying & Mapping	
<input type="checkbox"/> Auto Body Rebuilding Specialist	<input type="checkbox"/> CATV Techn.	MR. MRS. MISS	AGE
<input type="checkbox"/> Engineering (Civil, Electrical, Mechanical, Chemical)	<input type="checkbox"/> Electrician	ADDRESS	APT
<input type="checkbox"/> Computer Servicing	<input type="checkbox"/> Electronics Technician	CITY	STATE
	<input type="checkbox"/> Engineering Technician		ZIP

Circle 1 on reader service card



## The Wolfman... A howling success story.



The hottest radio happening since multiplex! He's Wolfman Jack, a personality extraordinaire and an independent production company. From his home/studio in Beverly Hills, California, Wolfman Jack pre-records his widely syndicated daily radio show almost entirely with Shure audio componentry. For vocal pickup, the Wolfman uses two of the finest Shure studio microphones: the "workhorse" SM53 unidirectional dynamic and the smoother-than-silk SM33 unidirectional ribbon. (His "outrigger" production console is a Shure M675 Broadcast Production Master used in conjunction with a Shure M67 Mixer.) A Shure M688 Stereo Mixer is used for stereo recording. Even in disc playback, Shure plays a vital role with a precision-engineered Shure-M232 professional tone arm and M44E Cartridge. Shure professional products doing their thing help the Wolfman do his thing. For your copy of our Professional Products Catalog, drop us a note — and see what we mean.

Shure Brothers Inc.  
222 Hartrey Avenue, Evanston, Illinois 60204  
In Canada: A. C. Simmonds & Sons Ltd.  
*Circle 2 on reader service card*





# Radio-Electronics

FOR MEN WITH IDEAS IN ELECTRONICS

MARCH 1973

## 4-CHANNEL STEREO HI-FI

- 35 How Good Is Matrix?**  
Better than you think, but far from perfect. Here's a look at what's happening right now. *by Eugene Walters*
- 39 Build A 4-Channel Power Amplifier**  
It delivers 60 watts rms per channel at .01% IM distortion. The perfect match for the "Zero Distortion" Preamp. *by Daniel Meyer*
- 43 Off-Beat 4-Channel Speaker Systems**  
Here are some unusual answers to the question, "How can I get four speakers into my listening room and have them look good?" *by Fred Petras*
- 51 Tape Bias Level And Recording**  
Small differences in the bias level can make a large difference in the quality of a tape recording. See what happens. *by Herb Friedman*
- 54 4-Channel Tape For Your Car**  
What's happening, what's available in 4-channel sound gear for the automobile. *by Frank Peters*
- 68 Hard Rock And Your Hearing**  
Music can soothe; sometimes it can hurt. Here is a report on what happens. *by Merino y Coronado*

## TELEVISION

- 58 Step-By-Step TV Troubleshooting**  
Inside the sync separator. *by Art Margolis*
- 69 Service Clinic**  
The "funny button." *by Jack Darr*
- 70 Reader Questions**  
R-E's Service Editor solves reader problems

## GENERAL ELECTRONICS

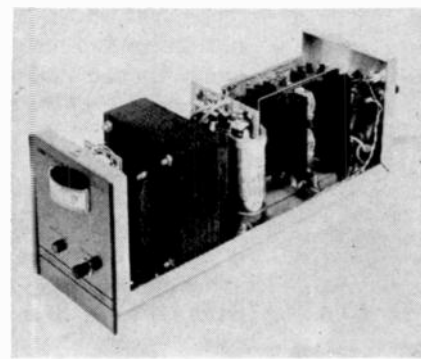
- 4 Editorial**  
C . . . E . . . T . . . three very important letters
- 6 Looking Ahead**  
Tomorrow's news today. *by Jack Darr*
- 26 Equipment Report**  
Radatron Auto Sentry
- 32 Appliance Clinic**  
All about timers. *by Jack Darr*

## SOLID-STATE ELECTRONICS

- 61 State-Of-Solid-State**  
A digital circuit dictionary plus data on several of the latest IC's and transistors. *by Lou Garner*
- 71 Transistor Interchangeability Directory**  
New list cross-references replacements of eight different manufacturers. *by Robert F. Scott*

## DEPARTMENTS

- |                            |                                |
|----------------------------|--------------------------------|
| <b>22 Letters</b>          | <b>82 New Products</b>         |
| <b>12 New &amp; Timely</b> | <b>100 Next Month</b>          |
| <b>96 New Books</b>        | <b>104 Noteworthy Circuits</b> |
| <b>86 New Literature</b>   | <b>98 Try This</b>             |



**4-CHANNEL POWER AMPLIFIER** delivers 60 watts per channel, at insignificant distortion levels. **see page 39**



**4-CHANNEL IN YOUR CAR.** There's a lot of new equipment available now. Here are the details. **see page 54**

Hugo Gernsback (1884-1967)  
founder  
M. Harvey Gernsback, editor-in-chief  
and publisher  
Larry Steckler, editor, CET  
Robert F. Scott, W2PWG technical editor, CET  
Jack Darr, service editor, CET  
Louis E. Garner, Jr., semiconductor editor  
J. Queen, editorial associate  
Matthew Mandl, contributing editor  
David Lachenbruch, contributing editor  
James A. Gupton, Jr., photographic electronics  
Vincent P. Cicania, production manager  
Nancy Gipsan, production assistant  
H. Matysko, circulation

Cover photograph by Walter Herstatt  
Cover design by Marius Trinque  
**Radio-Electronics** is indexed in *Applied Science & Technology Index* and *Readers Guide to Periodical Literature*.



Radio-Electronics, February 1973, Vol. 44, No. 2 Published monthly by Gernsback Publications, Inc., 200 Park Avenue South, New York City 10003. Second-class postage paid at New York, N. Y. and additional mailing office. One-year subscription rate: U.S.A., U.S. possessions and Canada, \$7. Pan-American countries, \$8. Other countries, \$8.50. Single copies 60¢. © 1973 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, Colo. 80302

## *CET—three important letters*

Certified Electronic Technician! These three words symbolized by the three letters, CET, identify a new kind of electronic technician. They signify the technician who has taken the time, effort and interest in proving to himself, his customers and his peers that he has established a bonafide level of knowledge; much the same as the lawyer who passes the state bar exam or the accountant who gets his CPA certificate.

Obtaining the right to use CET after your name is not easy. The test is a difficult one—carefully prepared so that a large proportion of those who take it fail it. The prerequisites for the test also require a level of experience in the field. In some states, where licensing laws currently exist, the CET certificate is required before the technician can be licensed to repair electronic equipment.

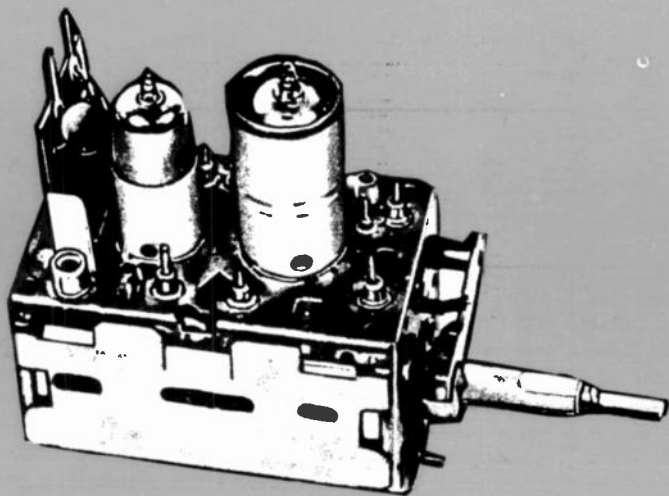
The number of technicians who display the CET certificate are growing rapidly as more and more technicians come to understand the reason for the certification program and what it does for them. The technician who holds a CET certificate should display it proudly as it represents an authoritative evidence of his skills and abilities.

**Radio-Electronics** strongly supports this program and, in fact, our editorial staff acts as monitors for the CET examinations given in the metropolitan New York area.

We urge that all technicians find out what the program is and what it offers. We would like to see every qualified technician become a Certified Electronic Technician and an active member of ISCET (The International Society Of Certified Electronic Technicians). If you require further information on the CET program or ISCET, please write to us. We will forward your inquiry to the proper organization for reply.

There is still room in many states to become a CET with a certificate number that is lower than 100. Take advantage of this opportunity now, and become one of the first Certified Electronic Technicians in your state. —Larry Steckler, CET, Editor





**\$9.75**  
ALL PARTS INCLUDED

ONE YEAR GUARANTEE

# TUNER SERVICE CORPORATION

**PROVIDES YOU WITH A COMPLETE SERVICE FOR ALL YOUR TELEVISION TUNER REQUIREMENTS.**

## REPLACE

Replacement Tuner \$9.75.

This price buys you a complete new tuner built specifically by SARKES TARZIAN INC. for this purpose.

All shafts have a maximum length of 12" which can be cut to 1½".

Specify heater type parallel and series 450mA or 600mA.

## REPAIR

VHF Or UHF Any Type \$9.75.  
UHF/VHF Combo \$15.00.

In this price all parts are included. Tubes, transistors, diodes, and nuvistors are charged at cost.

Fast efficient service at our 10 conveniently located service centers.

All tuners are cleaned inside and out, repaired, realigned and air tested.

## CUSTOMIZE

Customized tuners are available at a cost of only \$15.95.

Send in your original tuner for comparison purposes to:



### TUNER SERVICE CORPORATION FACTORY-SUPERVISED TUNER SERVICE

Backed by the largest tuner manufacturer in the U.S.—SARKES TARZIAN, Inc.

HEADQUARTERS	537 SOUTH WALNUT ST., Bloomington, Indiana 47401	TEL: 812-332-7251
ARIZONA	2629 NORTH FIRST AVE., Tucson, Arizona 85717	TEL: 602-791-9248
CALIFORNIA	SARKES TARZIAN, Inc. TUNER SERVICE DIVISION	
	10654 MAGNOLIA BLVD., North Hollywood, Calif. 91601	TEL: 213-769-2720
FLORIDA	1505 CYPRESS ST., Tampa, Florida 33606	TEL: 813-253-0324
GEORGIA	938 GORDON ST., S. W., Atlanta, Georgia 30310	TEL: 404-758-2222
INDIANA	817 N. PENNSYLVANIA ST., Indianapolis, Ind. 46204	TEL: 317-632-3493
	6833 GRAND AVE., Hammond, Indiana 46323	TEL: 219-845-2676
KENTUCKY	2920 TAYLOR BLVD., Louisville, Kentucky 40208	TEL: 502-634-3334
NEW JERSEY	547-49 TONNELE AVE., Jersey City, New Jersey 07307	TEL: 201-792-3730
	(On U. S. Highway 1 & 9)	
TENNESSEE	1215 SNAPPS FERRY RD., Greeneville, Tennessee 37743	TEL: 615-639-8451
	1703 LAMAR AVE., Memphis, Tennessee 38114	TEL: 901-278-4484
TEXAS	11540 GARLAND RD., Dallas, Texas 75228	TEL: 214-327-8413
VIRGINIA	4538 PRINCESS ANN ROAD, Norfolk, Virginia 23502	TEL: 703-855-2518

WATCH US GROW

Circle 3 on reader service card

# looking ahead

## Enter Disco-Vision

Discomania seems to be overtaking the television set manufacturers as they search for a new generation of video products. Most of them are also very closely researching the possibility of cartridge video-tape recorders for the home—some are already selling them. But the concept of the disc appears to have captured their imagination as a potential new entertainment medium that could provide pre-recorded visual information at a cost far below that of magnetic tape.

So far, three basic principles have been used in video discs: (1) The mechanical pressure-transducer system developed by German Telefunken, British Decca and their joint subsidiary Teldec. Zenith has also demonstrated its own system, based on Teldec principles. (2) An electrostatic-capacitance system developed by RCA, that had not been publicly demonstrated at press time. (3) The laser-optical system shown by Philips.

The third system, which Philips calls VLP (see *Radio-Electronics* December, 1972), was warmly received by those engineers who witnessed its first demonstration. Now, suddenly, a new system has entered the race—but one that so strongly resembles VLP that there is open discussion as to whether the two could eventually become compatible. The new system is Disco-Vision, developed by a subsidiary of MCA Inc., the entertainment colossus that owns Universal Pictures, several record labels and a TV program syndication company.

Although demonstrated with only seven minutes of program material, Disco-Vision's backers say that up to 40 minutes of color pictures

and stereo sound can be pressed into a single-sided plastic 12-inch disc with a reflective coating. The disc revolves at 1,800 rpm (or 30 revolutions per second, in synchronization with TV's frame rate) and is scanned by a 1-milliwatt helium-neon laser. The master disc may be made from film, video tape or a live television picture and is laser-etched in real time. Pressings are made in a manner similar to the replication of an audio phonograph disc. Although MCA demonstrated only a single-play Disco-Vision attachment for home TV sets (the signal is fed in through the antenna terminals), it showed a mockup of a proposed changer, which could accommodate up to 10 discs, which could provide up to six hours and 40 minutes of continuous visual material, interrupted only by a 4-second disc-changing cycle.

MCA believes the single-play attachment could sell for less than \$400, the changer for under \$500, and record albums for \$2 to \$10, depending on the length and content of the material. Although MCA hasn't yet decided whether to manufacture the hardware itself or farm it out to others, its officials say they are shooting at a late-1974 production target—which happens to be the target date for virtually all of the competitive systems. MCA also promises it will release movie albums from "the world's largest collection of feature films" in Universal Pictures' vaults.

## Videoplayer rules

A new FCC ruling should result in stronger, clearer pictures from those videodiscs as well as VTR's and other devices designed to be attached to the antenna terminals of home TV sets. Since

July 1961, when the FCC ruled it had jurisdiction over videoplayers under its authority to control radio-frequency interference, manufacturers of such "Class I TV devices"—which include most videoplayers as well as Magnavox's Odyssey TV game—have been operating under legal restrictions that some said guaranteed a noisy picture.

The most odious part of the rules was the provision limiting signal strength to a maximum of 2,000  $\mu\text{V}$  rms across a 300-ohm antenna terminal, or 1,000  $\mu\text{V}$  across 75 ohms (see *Radio-Electronics*, December, 1971). Last-minute modifications were made in various video devices to meet this restriction, but their makers didn't like it.

Now the final rules are out. As a result of the near-unanimous view of the industry that the earlier limit was too low to produce a good, clean picture, the FCC raised the limit to 6,000  $\mu\text{V}$  across 300 ohms and 2,000  $\mu\text{V}$  across 75 ohms. As a safeguard against video-players feeding out through antennas or CATV systems, the Commission added the requirement that these devices must be equipped with a 60-dB antenna-transfer switch to disconnect the receiving antenna when the videoplayer or other gadget is in use. The increase in signal strength permitted by the FCC is on the order of 10 dB and should help melt the snow that has often been a characteristic of videoplayers sold to date.

## CATV receivers

With cable TV now serving more than 10% of America's television receivers, and with all future cable systems required to carry at least 20 channels, FCC-backed indus-

try studies are now under way with a view toward standardizing CATV channels.

A large number of proposals for new channeling have been made. Some envision 24 to 34 extra cable channels not duplicating the present broadcast channels. Others involve the use of standard vhf channels, plus some extra new ones, as is now being done with converters. Still others foresee the use of multiple cables and the existing channels. In the latter case, a two-cable system would permit the transmission of two programs per vhf channel, the viewer merely turning a switch to change from Channel 2A to Channel 2B, switching from one cable to the others. A two-cable system would permit the use of 24 vhf channels, a four-cable system 48 channels.

How would these various plans affect receiver design and costs? Sylvania's Advanced Development Manager C. Bailey Neal has analyzed the various plans and concluded that the first two would unduly penalize viewers who are not connected to the cable, and add to the cost and bulk of television sets. The first plan, with the completely separate set of cable channels, his study indicated, would require an extra tuner twice the cost of the standard vhf tuner (which would also be in the set for off-the-air reception) and increase the cabinet size by three to four inches, expanding a 17-inch color set to the bulk of today's 19-inchers. The multi-cable approach was found to be the most practical from the standpoint of receiver design, requiring only the addition of a simple A-B (or A-B-C-D) switch to change channel inputs.

R-E

by DAVID LACHENBRUCH  
CONTRIBUTING EDITOR



# SONY 1055 and 5055

## One good Sony deserves another



Sony offers you eleven individual choices in tuners, amplifiers and preamps, plus an infinite variety of combinations. For every listening requirement in every price range. We're going to tell you about two new low-priced models that offer all the traditional Sony performance and value.

The Sony TA-1055 delivers 23+23W RMS continuous power into 8 ohms per channel, from 20Hz to 20kHz. The power you pay for is the power you get, at every frequency from low, low bass (where you really need it) right up to the highest highs. And these Sony circuit features keep that power

clean and quiet—direct coupled differential output and wide range, integrated circuit phono preamp. It has all the operating features, including such luxury touches as two sets of tape output and monitor connections (use one for an SQ decoder) with direct dubbing, front panel Aux and MIC inputs and slide controls. \$149.50.

The deserving tuner for the TA-1055 is Sony's ST-5055. Its sensitivity is 2.2 $\mu$ V IHF, moderate by today's standards, but when you combine it with a capture ratio of 1 dB, performance is outstanding. There's a high blend switch for quiet stereo reception of

weak signals, built in AFC, signal-strength meter and switchable muting. The price, including walnut finish cabinet, \$159.50.

Each is the lowest priced tuner and amplifier offered by Sony. Imagine the performance and value offered by the nine other models. Sony's wide selection of deserving amplifiers and tuners goes right on up to the ultimate combination of the super-powered 3200F, deluxe 2000F preamp, and 5130 tuner at \$1238. Visit your dealer and audition these Sonys. You deserve it. Sony Corporation of America, 47-47 Van Dam St., L. I. City, N.Y. 11101.

All prices suggested retail.

**Sony Tuners and Amplifiers now start at \$149.50.**

Circle 4 on reader service card

MARCH 1973 • RADIO-ELECTRONICS 7



# firsts

make learning  
**Electronics at home**  
fast and fascinating—  
give you priceless  
confidence.

Some NRI **firsts** in training equipment



**first** to give solid state 25" color TV, 5" wide band oscilloscope, color bar generator and other professional equipment engineered specifically for education. You work directly on the receiver as you build it, discovering the practical aspects of TV servicing as you create a handsome new color console. Only NRI includes an attractive woodgrain cabinet without extra charge.



**first** to give you a unique, exciting digital computer *with memory* built especially for home training. You learn organization, trouble shooting, operation, programming as you build and use it. Performs the same functions as commercial computers. Lessons stress computer repair. You conduct a hundred experiments, build hundreds of circuits. A solid-state VTVM is included among ten training kits.



# NRI's "discovery" method is the result of over half a century of leadership simplifying and dramatizing training at home

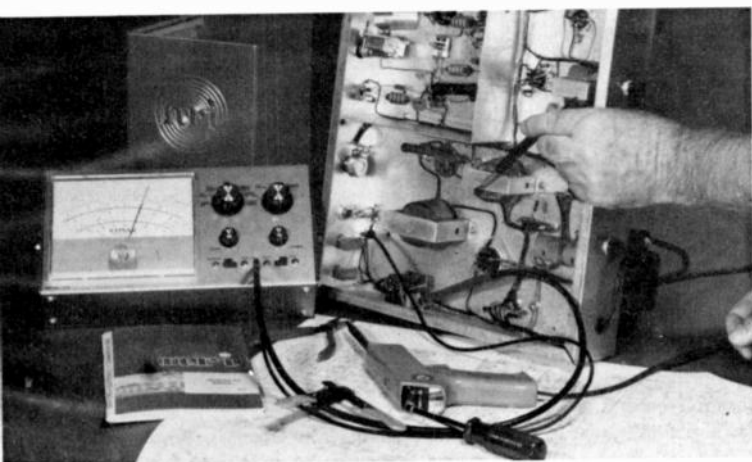
The FIRSTS described below are typical of NRI's half century of leadership in Electronics home training. When you enroll as an NRI student, you can be sure of gaining the in-demand technical knowledge and the priceless confidence of "hands-on" experience sought by employers in Communications, Television-Radio Servicing and Industrial and Military Electronics. Everything about NRI training is designed for your education . . . from the much-copied, educator-acclaimed Achievement Kit sent the day you enroll, to "bite-size" well-illustrated, easy to read texts programmed with designed-for-learning training equipment.

## YOU GET YOUR FCC LICENSE OR YOUR MONEY BACK

There is no end of opportunity for the trained man in Electronics. You can earn \$6 or more an hour in spare time, have a business of your own or qualify quickly for career positions in business, industry, government. And if you enroll for any of five NRI courses in Communications, NRI prepares you for your FCC License exams. *You must pass* or NRI refunds your tuition in full. No school offers a more liberal money-back agreement. The full story about NRI leadership in Electronics training is in the new NRI Catalog. Mail postage-free card today. No salesman is going to call  
NATIONAL RADIO INSTITUTE, Washington, D.C. 20016 (In Canada write: NRI Rep., 330 Progress Ave., Scarborough, Ont.)

**APPROVED UNDER NEW GI BILL** If you have served since January 31, 1955, or are in service, check GI line on postage-free card.

## designed from chassis up for your education



**first** to give you true-to-life experiences as a communications technician. Every fascinating step you take in NRI Communications training, including circuit analysis of your own 25-watt, phone/cw transmitter, is engineered to help you prove theory and later apply it on the job. Studio equipment operation and troubleshooting become a matter of easily remembered logic.



**first** to give you completely specialized training kits engineered for business, industrial and military Electronics. Shown above is your own training center in solid state motor control and analog computer servo-mechanisms. Telemetry circuits, solid-state multi-vibrators, and problem-solving digital computer circuits are also included in your course.

# new & timely

## Beeping traffic signals help blind cross streets

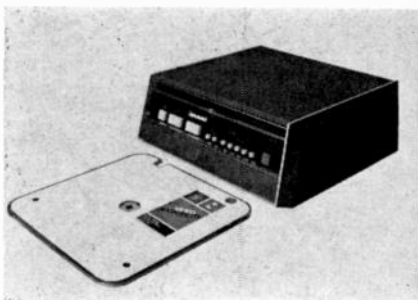
An electronic traffic signal that combines the traditional red and green lights with a loud beeping during the first 5 seconds of the green light period has been installed at a Vienna street crossing adjacent to a school for the blind. It has had such excellent results that Viennese authorities are promising more.

A blind American electronics instructor points out that the blind are especially helpless at a street crossing. "You just listen till you hear no sound from either direction, then run like hell and trust to luck." With the beep signal, the blind pedestrian knows that there are 12 seconds to cross after the 5-second beeping stops.

"But," says one student, there is another advantage—the driver respects the sound-and-light signal more than a conventional light. "When we had normal lights," he said, "drivers used to roar away on the green as if they were on a racetrack, regardless whether a pedestrian—blind or not—was in the way. Now they have more respect."

## "Floppy-disc" video recorder can make X-rays safer

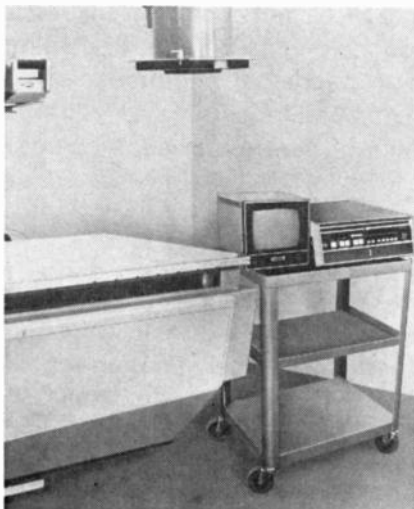
Reduction of doctor and patient exposure to X-rays by as much as one-half in such examinations as barium swallows, and even more in other procedures, is promised with a new magnetic video disc recorder, which can record and play back up to 600 pictures from a single disc cartridge.



THE DICASSETTE, with its cartridge disc.

In a barium swallow, for example, the patient swallows a barium solution to make his upper digestive system visible. The doctor watches the TV monitor carefully to discover problems. If he sees something interesting, he presses a foot switch that takes a photograph. The X-ray procedure goes on while the doctor

is waiting for the film to be developed, and only after the full X-ray session is the doctor in possession of the photos that may solve his problem for him.



TYPICAL X-RAY SET-UP, including the examination table, TV monitor and Dicassette.

With the Dicassette recorder, the doctor presses a foot switch that gives him an instant video snapshot. The recorder freezes the scene, giving the doctor a still picture he can study as long as desirable. In many cases, the X-ray examination can be terminated immediately, as soon as the doctor is sure he has found the trouble, thus saving the patient unneeded exposure to the rays.

The new recorder, made by Arvin Industries, has two advantages over equipment now in use. It takes an absolutely stable picture, something that cannot be accomplished with the standard helical-scan tape recorder, and it uses a low-cost, easily interchangeable flexible disc, in contrast to the expensive and critical plated aluminum discs of existing recorders with equal picture stability. Listing for \$4,000, with a cartridge disc selling for \$25, its manufacturer calls it a breakthrough in reliability, simplicity and price.

Each Dicassette cartridge contains 600 stable full-revolution still frames. Cassettes can be changed rapidly—less than 20 seconds from lock-up to lock-up. Pictures can be played back at 1, 3, 6 or 15 frames a second, giving stop motion, slow motion or full motion. A stack of disc cartridges four inches high can hold as many as 10,000 pictures. Any one is immediately accessible, and any one can

be updated or replaced without disturbing the other images.

Aside from the medical field, the recorder has many applications in training, industrial applications, security, banks, educational TV and CATV. Animation offers a particularly promising field.

## New upgraded program planned for unified service training

A two-day pilot session of a new program designed to overcome some of the service technician's problems of receiving information on new design features and circuitry in TV-electronics equipment, and in participating in advanced service training will be conducted in Indianapolis March 19th and 20th. It is being launched by a group including the organized service technicians (NEA), the manufacturers and the Electronic Industries Association (EIA).

The main weaknesses in present-day training methods, which the new program is intended to correct or ameliorate, are:

1. Manufacturers' service training sessions easily available to service technicians usually cover only the most popular brands.

2. It is estimated that to keep up with current information on even the popular brands, a technician would have to spend at least two evenings a week attending training sessions. Many technicians, realizing that they cannot attend all the sessions, attend none.

3. Considerable material at the various service meetings is—necessarily—duplicated for each brand of receivers.

The new approach has been named JESUP—Joint Electronics Service Upgrading Program. The first two-day pilot training program will be broken down into general sessions of an hour each, in which authorities discuss such subjects as feedback circuits (agc, aft, acc) TV alignment, solid-state troubleshooting techniques, for example, and into special sessions of two hours, in which students break down into 20-man teams to work actively on electronic equipment under the direction of manufacturer training directors.

It is expected that the lessons learned in the JESUP two-day pilot program in March will be used to debug, modify and form the permanent program,

(continued on page 14)

# RCA antennas- your answer for the 2 toughest questions you get.

1. "How do I get a better picture?"

2. "What does it cost?"

With RCA in your inventory, you'll never have to turn down a sale because you don't have the right image-improver. RCA has everything for every reception problem—a complete line of outdoor antennas, rotators, reception aids and hardware. Each RCA product is a precision engineered, top quality performer in its class. All carry the RCA name that your customers know they

can depend on. And the complete array of models gives you a full range of prices to bargain from, too.

Next time you get a tough question from a customer, make sure you have RCA on hand to answer it for you.

See your RCA Parts and Accessories distributor today, or contact RCA Parts and Accessories, Deptford, N.J. **RCA**



# IS YOUR PREAMPLIFIER AS GOOD AS YOUR EARS?



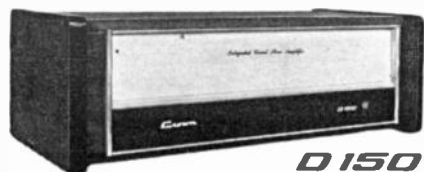
**IC 150**

Your first preamplifier was probably a kit or prebuilt economy model with minimum quality and just the basic features. Since then you no doubt have become more discerning and can hear more music than your old preamp "lets through". Perhaps it is hindering the development of your music appreciation?

We suggest that you consider the new Crown IC150 control center for significantly increased enjoyment. For example, does the loudness control on your present unit really do much? The IC150 provides beautifully natural compensation whatever the volume. Similarly, your tone controls may give inaccurate effects, while the IC150 has new "natural contour" exponential equalizers for correct compensation at low settings. Is your preamp plagued with turn-on thump and switching pops? Crown's IC150 is almost silent. The three-year parts and labor warranty is based upon totally new op-amp circuitry, not just a converted tube design.

Most dramatic of all is the IC150 phono preamp. No other preamplifier, regardless its price, can give you disc-to-tape recordings so free of distortion, hum or noise, and so perfect in transient response. It also has adjustable gain controls to match the exact output of your cartridge.

These are some of the refinements which make the IC150 competitive with \$400 units, although you can own it for just \$269. Only a live demonstration can tell you whether you are ready to graduate to the IC150 and explore new horizons in music appreciation. May we send you detailed product literature today?



**D 150**

Ask your dealer also about Crown's new companion D150 power amplifier, which delivers 150 watts RMS output at 8 ohms (150 watts per channel at 4 ohms). No amp in this power range - however expensive - has better frequency response or lower hum, noise or distortion. It offers performance equal to the famous DC300, but at medium power and price. It's worth listening into!



BOX 1000, ELKHART, INDIANA, 46514, U.S.A.  
Circle 6 on reader service card

## new & timely (continued from page 12)

which will probably be expanded to cover the country within the year. Program publicity and promotion are handled by Joe Groves, manager of Photo-Facts at Howard W. Sams Co.

### Hugo Gernsback scholarship winner

Donald O'Rourke, 27, Brooklyn, N.Y., is the winner of the last of the second Hugo Gernsback Annual Scholarship Awards. These awards are in the form of \$125 grants made to home-study students of electronics. Eight are made each year, to outstanding students in each of eight home-study schools.

Donald O'Rourke joined the U.S. Navy in 1962, immediately after leaving high school. He served aboard the aircraft carrier U.S.S. Constellation as Aviation Jet Mechanic until 1965. Separating from the Navy, he joined the New York Police Department as Patrolman, and is now working in the Medical Section of the Police Academy in New York City.



He became interested in electronics, he says, because of "the many opportunities in this field," which, he points out, has now expanded to encompass areas as far apart as space technology and the needs of everyday living, and almost everything in between. He enrolled in a Master Television Service course with the RCA Institutes, without any previous electronics experience. "I have found the course very interesting," he says, "not only learning basic electronic theory, but attaining practical experience in building test equipment and television receivers."

After completing his studies Mr. O'Rourke expects to work part-time in TV servicing, with the eventual prospect

of having his own business.

Mr. O'Rourke has a wife, Elaine, and one son, Patrick, age 2.

### Second-year guarantee offered on 25-inch TV's

A free second-year parts and labor warranty—said to be the first ever made by an American manufacturer—is being offered by Philco-Ford on three new 25-inch diagonal solid-state console color receivers during its annual "One Idea Better" sale, which began in late December and runs through March. The second-year warranty has an estimated value of up to \$100, according to a survey of major TV service organizations.

The warranty is standard on the new consoles during the sale only, and is optional on all other 25-inch diagonal modular solid-state sets.

### NEA-NATESA move toward unity

Presidents of the two national service organizations, at a meeting of members of their merger committees and boards in Nashville, Ind., November 30 last, agreed that the two associations might be able to merge in a matter of months. Members of both organizations, they indicated, were still unclear in their understanding of the proposed details of the anticipated consolidation, and time will be required to make all points clear and to solve all vital issues before the merger.

Meanwhile the two organizations are cooperating closely on several mutual projects, including the joint annual convention in Kansas City, August 1973, and their joint effort to improve the design of products by manufacturers to bring about better serviceability.

### FCC authorizes new type of common-carrier service

By the authorization of a new type of microwave common-carrier service, the FCC has created a new communications medium that may make possible hundreds of low-cost private television networks for business, institutional, government or entertainment use. The new *Multipoint Distribution Service* (MDS) is a common-carrier telecommunications system on which anyone may purchase time. MDS stations, as common carriers, will not be permitted to produce or con-

*(continued on page 16)*

## The big difference in TV Alignment instruments: Ours Works.

The B & K Model 415 Sweep/Marker Generator not only works, but it makes alignment jobs faster and more accurate.

Why? Because it eliminates the need for a separate marker generator, sweep generator, marker adder, and bias supply. You get it all in one compact instrument.

And it's so easy to use. The IF and chroma bandpasses are simulated on the front panel for constant reference. Lights tell you which of the crystal-controlled markers are in use and where they should be located. And the exclusive marker tilt feature lets you place the markers either horizontally or vertically, so you can always identify their exact positions.

Put the B & K Model 415 Sweep/Marker Generator to work for you.

Ask your distributor for complete details.



Product of  
DYNASCAN CORPORATION  
1801 W. Belle Plaine  
Chicago, Illinois 60613



Model 415:  
\$399.95

Circle 7 on reader service card

# FREE

send now for the *all new*

# Olson

## 1973 CATALOG



### Your Savings Guide to Everything in Electronics

Here's your NEW and complete annual buying guide to:

- Everything in audio & hi-fi
- Tape recorders & accessories
- Radios & phonos of all kinds
- New build-your-own kits
- Auto electronics & accessories
- Citizens Band two-way radios
- VHF & UHF police/fire monitors
- Amateur & shortwave radio
- Electronic security equipment
- TV-FM antennas • Test gear
- Books, parts bargains, tubes, transistors, wire, more!

**NOW!** Send for the only catalog with a wide selection of **THE BEST OF THE FAMOUS BRANDS**

**OLSON EXCLUSIVES!**

See special products & values sold only by Olson including our all-new **TELEDYNE** stereo line.

Many full-color pages!

### Olson Electronics



Olson Electronics Dept. LD  
260 S. Forge St., Akron, Ohio 44327  
 Send FREE 1973 Olson catalog

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

Address \_\_\_\_\_

City \_\_\_\_\_

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

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

Address \_\_\_\_\_

City \_\_\_\_\_

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

Circle 8 on reader service card

# new & timely (continued from page 14)

trol the programs they transmit, but will make their services available to anyone on a first-come-first-served basis.

MDS operates in the 2150-MHz (2.15 GHz) band and is designed to transmit encoded signals to any number of locations within a 25-mile radius. Receiving locations are equipped with parabolic antennas and equipment to decode the signals and convert them down to regular television channels, when they may be displayed on an ordinary television receiver.

Since program transmissions are address-encoded for a pre-determined set of reception points, purchasers of time on the system are assured of security. A company, for instance, may buy time to telecast a confidential sales meeting to ten locations within a metropolitan area. Only those ten locations can receive the program. At the end of that company's time, another user may transmit, say, a training session to 50 other locations in the area. None of the signals can be picked up by receivers of the first group, or by other MDS users in the network.

Possible uses for the new system

approach the infinite and are limited practically only by the imagination of the potential users. That this imagination may be lively appears from the fact that more than 300 license applications had been filed for more than 160 cities by the middle of last November.



**SPECIAL RECOGNITION CERTIFICATE** is awarded to Radio-Electronics magazine by the National Electronics Associations, Inc. for "much appreciated assistance on the Certified Electronics Technicians examination program 1972." The award was presented on behalf of NEA by Lew Edwards (right) and accepted by Larry Steckler, Editor. R-E

Radio-Electronics is published by Gernsback Publications, Inc. 200 Park Ave. S. New York, N.Y. 10003 (212) 777-6400  
President: M. Harvey Gernsback  
Secretary: Bertina Baer

#### ADVERTISING SALES

##### EAST

Stanley Levitan, Eastern Sales Mgr.  
Radio-Electronics  
200 Park Ave. South  
New York, N.Y. 10003  
(212) 777-6400

##### MIDWEST/Texas/Arkansas/Okla.

Ralph Bergen  
The Ralph Bergen Co.  
6319 N. Central Ave.  
Chicago, Ill. 60646  
(312) 792-3646

##### PACIFIC COAST/Mountain States

Jay Eisenberg  
J.E. Publishers Representative Co.,  
8560 Sunset Blvd.,  
Suite 601,  
Los Angeles, Calif. 90069  
(213) 659-3810  
420 Market St.,  
San Francisco, Calif. 94111  
(415) 981-4527

##### SOUTHEAST

E. Lucian Neff Associates  
25 Castle Harbor Isle,  
Fort Lauderdale, Florida 33308  
(305) 566-5656

### MOVING?

Don't miss a single copy of **Radio-Electronics**. Give us:

Six weeks' notice

Your old address and zip code

Your new address and zip code

ATTACH LABEL HERE

name (please print)

address

city state zip code

Mail to: Radio-Electronics  
SUBSCRIPTION DEPT., BOULDER, COLO.  
80302



# Speaker super market? Super speaker market.



In a super market, you get a big selection, low prices, nationally-advertised merchandise. Make Quam your speaker super market.

Pick the size, power handling capacity, and price you need to match the function: public address, background music, intercom, outdoor, or whatever. We have 60,000 speakers, 135 different models, ready to transfer from our shelf to your wagon.

What makes a super speaker market? Super performance speakers. That's Quam, too. We use only top grade materials, stringent quality control, and advanced manufacturing methods to make sure our speakers work the way your customer expects them to.

Quam Nichols Company  
Chicago, Illinois 60637  
Phone: (312) 488-5800

Write for a copy of  
our super new  
Catalog 72



## Quam: *The Sound Decision*

**Hunting for  
a better job?**

**CIE will  
help you get  
the license  
you need**



**A Government FCC License can help you qualify for an exciting, rewarding career in ELECTRONICS, the Science of the Seventies. Read how you can prepare for the license exam at home in your spare time — with a passing grade assured or your money back.**

**I**F YOU'RE OUT TO BAG A BETTER JOB in Electronics, you'd better have a Government FCC License. It will help you track down the choicest, best-paying jobs in the growing field of Electronics.

Demand for people with technical skills is growing twice as fast as any other group, while jobs for the untrained are rapidly disappearing. Right now there are thousands of new openings every year for electronics specialists. And you don't need a college education to qualify!

But you *do* need knowledge, knowledge of electronics fundamentals. And there is only one nationally accepted method of measuring this knowledge . . . the licensing program of the FCC (Federal Communications Commission).

**Why a license is important**

An FCC License is a legal requirement if you want to become a Broadcast Engineer, or get into servicing any other kind of transmitting equipment — two-way mobile radios, microwave relay links, radar, etc. And even when it's not legally required, a license proves to the world that you understand the principles involved in *any* electronic device. Thus, an FCC "ticket" can open the doors to thousands of exciting, high-paying jobs in communications, radio and TV broadcasting, the aerospace program, industrial automation, and many other areas.

So why doesn't everyone who wants a good job in Electronics get an FCC License?

It's not that simple. You must pass a Government licensing exam. A good way to prepare for your FCC exam is to take a licensing course from Cleveland Institute of Electronics.

Our training is so effective that, in a recent survey of 787 CIE graduates, better than 9 out of 10 CIE grads passed the Government FCC License exam. That's why we can offer this famous Money-Back Warranty: when you complete any CIE licensing course, you'll be able to pass your FCC exam or be entitled to a full refund of all tuition paid. This warranty is valid during the completion time allowed for your course. You get your FCC License — or your money back!

And with CIE, you learn at home in your spare time. With AUTO-PROGRAMMED\* Lessons, you'll pick up the facts, figures and electronics theories you

**CIE HAS CAREER COURSES TO FIT YOUR BACKGROUND**

**ELECTRONICS TECHNOLOGY** with LABORATORY . . . teaches you the fundamentals. With a 161-piece laboratory you apply the principles you learn by analyzing and trouble-shooting electronics equipment.

**ELECTRONICS ENGINEERING** . . . A college-level course for men already working in Electronics. Covers steady-state and transient network theory, solid-state physics and circuitry, pulse techniques, computer logic and mathematics through calculus.

may have considered "complicated" . . . even if you've had trouble studying in the past.

**CIE Grads get licenses . . . better jobs**

The value of CIE training has been demonstrated time and again by the achievements of our thousands of successful students and graduates.

An outstanding example is Ed Dulaney of Scottsbluff, Nebraska. He passed his 1st Class FCC License exam soon after completing his CIE course. Today, he owns two companies . . . one to manufacture and distribute two-way radio equipment, the other to maintain and repair such equipment along with home radio, TV and stereo sets. He says: "In the last three years we sold more than \$1,500,000 worth of equipment through dealers in every state plus Canada, South America and Europe."

Richard Kihn, Anahuac, Texas, worked in the engine room of a tugboat when he started his CIE training. He reports, "Before finishing, I got my FCC License and landed a job as broadcast engineer at KFDM-TV in Beaumont, Texas. I was able to work, complete my CIE course and get two raises . . . all in the first year of my new career in broadcasting."

**Send for FREE books**

If you'd like a chance to succeed like these men, send for our FREE book, "How To Get A Commercial FCC License." It tells you all about the FCC License . . . requirements for getting one . . . types of licenses available . . . how the exams are organized and what kind of questions are asked . . . where and when the exams are held, and more.

With it, you will also receive a second FREE book, "Succeed in Electronics." For your convenience, we will try to have a representative call. Send for both books today.

**APPROVED UNDER G. I. BILL**

All CIE career courses are approved for educational benefits under the G.I. Bill. If you are a Veteran or in service now, check box for G.I. Bill information.

**CIE Cleveland Institute of Electronics, Inc.**

1776 East 17th Street, Cleveland, Ohio 44114  
Accredited Member National Home Study Council

**Cleveland Institute of Electronics, Inc.**

1776 East 17th Street, Cleveland, Ohio 44114

Please send me your two FREE books:

1. Your book on "How To Get A Commercial FCC License."
2. Your school catalog, "Succeed in Electronics."

I am especially interested in:

- |   |  |
|---|--|
| <input type="checkbox"/> Electronics Technology                 | <input type="checkbox"/> Electronic Communications |
| <input type="checkbox"/> Broadcast Engineering                  | <input type="checkbox"/> Industrial Electronics    |
| <input type="checkbox"/> First Class FCC License                | <input type="checkbox"/> Electronics Engineering   |
| <input type="checkbox"/> Electronics Technology with Laboratory |  |

Name \_\_\_\_\_ (PLEASE PRINT)

Address \_\_\_\_\_

City \_\_\_\_\_

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

**Veterans and Servicemen:**

Check here for G.I. Bill information.

RE-14



Dreaming  
about a pair  
of \$300  
condenser  
microphones?

Think  
seriously  
about these:  
\$39.75\* each!



Model 1710 Electret Condenser  
Omnidirectional Microphone

All of the great condenser advantages are here without compromise. Flat, extended range, excellent transient response, high output, low noise, and ultra-clean sound. But the new E-V electret condenser microphones need no high voltage power supply. Just an AA penlite battery to operate the built-in FET impedance converter. The result is studio performance without complications and at a dramatically lower price.

There are 4 new E-V electret microphones, including cardioid models, from \$39.75 to just \$75.00, audiophile net. Second-generation designs with unusually high resistance to heat and humidity. Hear them today at your nearby Electro-Voice soundroom. Or write for details.

More U. S. recording studios use Electro-Voice microphones than any other brand.

\*Suggested retail price. Microphones shown on Model 421 Desk Stand, \$12.00 each.

**Electro-Voice®**

ELECTRO-VOICE, INC., Dept. 332E  
613 Cecil Street, Buchanan, Michigan 49107  
In Europe: Electro-Voice, S. A., Römerstrasse 49,  
2560 Nidau, Switzerland

**Gulton**  
COMPANY

Circle 11 on reader service card

22 RADIO-ELECTRONICS • MARCH 1973

## letters

### DIGITAL CLOCK CORRECTION

Mr. Larry Sullivan has called our attention to an error in the schematic in his article "Inside the IC Digital Clock" in the February issue. In Fig. 2, page 37, the line connecting the common side of resistors R6 through R18 is shown going to ground. This connection is wrong. The line joining these resistors should go to -35 volts as the collector of the 2N3906; and to ground only through potentiometer R5.

### PREDICTIONS

Reading some of Bob Gerson's predictions for TV in the annual TV issue brings back memories of many earlier annual TV issues, and I note that TV hasn't really changed much in 20 years.

Bob makes many predictions of things to come. We shall wait and see. In the meantime, I will have to go along with "old timer" Jack Darr on the modular sets. Chances of any module standardization are very remote and there won't be any drugstore module testers for that reason.

Designing and marketing a module tester to test all present and future modules are formidable engineering and sales tasks. Economical testing of modules in the field will come about only when sales competition forces it, just as sales competition forced all other changes.

Today, sales competition on modular sets is very slight. They are high-cost top-of-the-line sets. I'm sure that manufacturers build in the replacement cost of defective modules during the warranty period. So why would they add a module-tester plug to each chassis and provide a plug-in module tester?

DAVID R. MCKNIGHT  
Norwalk, Conn.

Certainly, the manufacturer has built in a cost factor to allow for warrantee repairs, but he does that on every product he manufactures, as does every other manufacturer—it isn't done only for modular color TV's.

Why would he build in a module-test jack? Serviceability! The more serviceable the set, the less expensive the repair, the more likely the set owner is to buy that brand again.—Editor

### ENGINE TIMING WITH A VOM

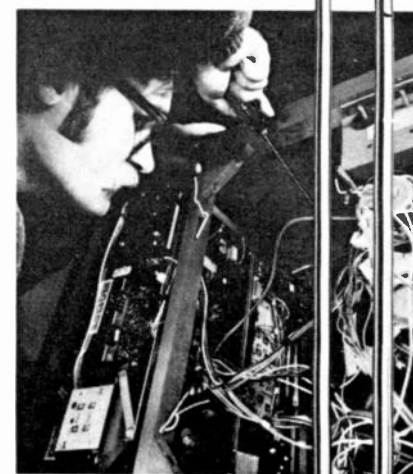
After reading through the method presented by Radio-Electronics for set-  
(continued on page 24)

NEW  
TV/radio/Hi Fi

fix-it  
tools



make tricky jobs easy



### SUPER LONG NUTDRIVERS

Over 20" long with 1/4" and 5/6" hex openings, color-coded plastic (UL) handles, full length hollow shafts.

Eliminate skinned knuckles and the frustration of trying to reach tuners, bezels, other up-front components from the back of a TV set with ordinary tools.

Extra length means more convenience, greater driving power for many other "fix-it" jobs.

### INVERTED PALNUT DRIVER SHANKS

Fit all Xcelite "99" handles, including Tee and ratchet types. Popular 7/16" and 1/2" external hex sizes, hollow shanks.

Save time, prevent damage to fastener or equipment when removing Palnuts on balance controls, on-off switches, volume control shafts of most TV sets, record players, portable radios.

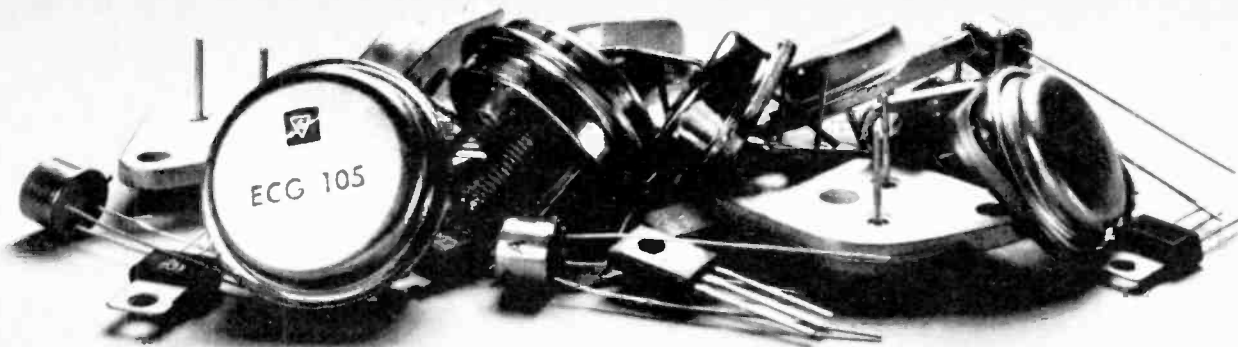


nationwide availability through  
local distributors

REQUEST BULLETIN N470

**XCELITE®**

XCELITE INC., 10 BANK ST., ORCHARD PARK, N. Y.  
In Canada contact Charles W. Pointon, Ltd.  
Circle 12 on reader service card



## Our 39 audio power transistors replace...

To Be Replaced	ECG Replacement	To Be Replaced	ECG Replacement
AD138	121	QP 1A	175
AD138/50	121	QP 2	175
AD139	104	QP 3	175
AD140	121	QP 4	175
AD142	179	QP 5	179
AD143	179	QP 6	179
AD143H	179	QP 7	179
AD148	131	QP 8	130
AD149	104	QP 8-1	130
AD149-01	121	QP 8-P	130
AD149-02	121	QP-10	179
AD149B	121	QP-11	130
AD150	121	QP-12	130
AD152	131	QP-13	185
AD155	131	QP-14	184
AD156	131	QP8-6623N	105
AD157	131	QP-13	153
AD159	121	QP-14	152
AD16C	175	QOC61209	158
AD161	155	QOC61210	102A

# and thousands more.

There are a lot of identical transistors around hiding under different manufacturers' part numbers.

But we've boiled power transistors down to just 39 types that will handle almost all of your replacement problems.

And we've also put together a cross-reference guide that tells you which one replaces which.

Our cross-reference guide also tells you about the rest of our ECG replacement semiconductor line. Altogether they can substitute for 53,000 others.

Practically everything from diodes to integrated circuits.

And we don't stop there.

The ECG semiconductor line includes a variety of heat sinks, heat-sink compounds, transistor mounting kits, and sockets.

In short, carrying Sylvania's ECG replacement semiconductor line can take a big load off your back.

And you can still give power to the people.

Sylvania Electronic Components,  
Waltham, Mass. 02154.

**GTE SYLVANIA**

## LETTERS

(continued from page 22)

ting the timing of an automobile engine with a vom or vtvm (August 1971, page 75) I've come up with an alternate method that I feel is superior to the earlier method because:

1. No need to remove the distributor cap or spark plug.
2. Engine can be timed to its specifications and not just top dead center.
3. Depending on the condition of the distributor, I think the above method is as accurate as a timing light.

Here's how it works, using the ohms scale:

1. Rotate the engine by hand to align timing marks on flywheel to specified timing for the particular engine.
2. With the vom/vtvm set to read the battery voltage, connect it between the point connection to the coil and ground.
3. Turn the ignition key on but do not start the engine.
4. Adjust the distributor to the point where a meter reading occurs. At this time the points have just opened and the meter will read the battery voltage. The engine is now timed.

J. KENNETH BERTRAM  
Asbury, N.J.

R-E

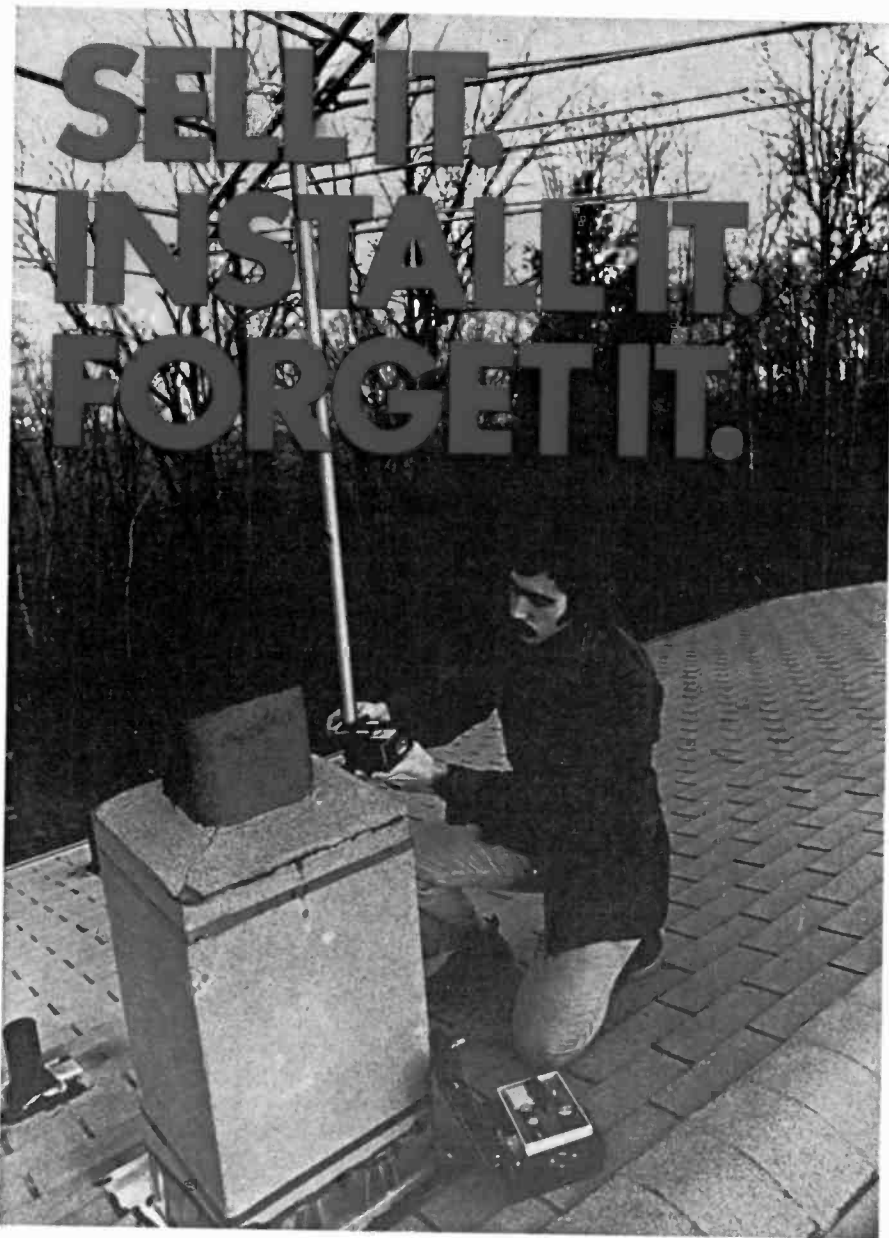
## What he needs, money can't buy.



There are boys who need fathers. Guys in veterans' hospitals who need someone to visit them. Old people who need someone to talk to. Kids who need tutors.

We know lots of people and groups who need your help. Write "Volunteer," Washington, D.C. 20013.

**We need you.**   
The National Center for  
Voluntary Action.



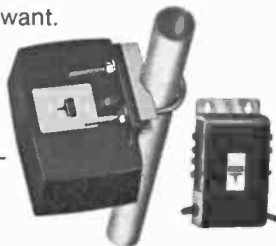
Call-backs are just what you and your customers' don't want. Once you install the B-T Horizon VHF two-set amplifier, you can forget it, because it's quality built to be reliable. It's the mast-mounted amplifier that thousands and thousands of TV installers have found "stays on the roof."

What makes Horizon so reliable? Solid-state, trouble-free circuitry. Four-way lightning and surge protection. Temperature compensation for all-weather reliability, and two individual amplifier circuits—one for Ch. 2-6 and the other for Ch. 7-13.

But the Horizon would not stay on the roof long if it didn't perform. And perform it does. It's back-matched for clearer color pictures. The patented ICEF circuit delivers wide dynamic range so that strong signals won't overload weak ones. It delivers more than ample gain for weak to medium signal areas for up to two TV sets.

And these are the reasons that made the Horizon one of the fastest and best sellers ever, and once it's sold, forget it. B-T has the industry's broadest line of home and MATV TV signal amplifiers—indoors and outdoors. Available from Blonder-Tongue distributors.

For solutions to your reception problems write:  
Blonder-Tongue Systems Engineering Dept.  
One Jake Brown Rd., Old Bridge, N.J. 08857.

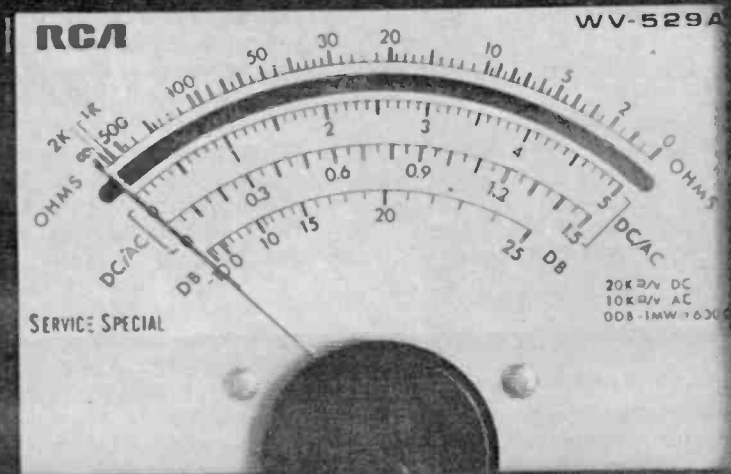


**BLONDER TONGUE**

Circle 13 on reader service card



## EVERYTHING YOU ASKED FOR IN A VOM FOR ONLY \$53.50\*



The new RCA WV-529A "Service Special" VOM features:

- Taut-band meter movement with mirror scale for accuracy.
  - Diode protected against burnout.
  - High-impact plastic case with recessed panel for rugged handling.
  - Measures up to 5,000 volts DC without add-on accessories to meet a broader range of servicing needs.
  - Input polarity reversal switch for DC voltage and current measurements. Also reverses battery polarity in ohms function — aids in solid-state servicing.
  - Fuse — mounted on front panel for easy access — protects ohms circuits.
  - 3-color coded panel and meter face for faster function identification.
  - Convenient 3-to-1-step ranges (VTVM-type).
  - One-year warranty on parts and labor . . . local replacement parts availability.
- Try the new RCA WV-529A today and see for yourself why we believe it offers the best price/performance combination on the market. For more information, contact your RCA Distributor. Or write RCA Test Equipment Headquarters, Harrison, N.J. 07029.

# RCA

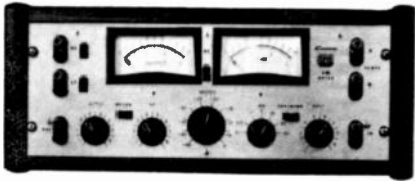
Electronic Components

\*Optional Distributor Resale Price, complete with test leads, batteries, and spare fuse.

International Sales Offices:  
 CANADA-21001 No. Service Rd.,  
 Ste. Anne de Bellevue, 810 Quebec/  
 ARGENTINA-Casilla de Correo  
 4400, Buenos Aires/BRAZIL-Caixa  
 Postal 8460, São Paulo/ENGLAND-  
 Sunbury-on-Thames, Middlesex/  
 HONG KONG-P.O. Box 112/MEXI-  
 CO-Apartado 17-570, Mexico 17,  
 D.F./SWITZERLAND-2-4 rue du  
 Lievre, 1227 Geneva.

# DISTORTION-TEST AUDIO EQUIPMENT

- easily
- quickly
- accurately



Now the TECRON IMA makes measuring IM distortion even easier than measuring THD!

Just one piece of equipment has both internal oscillators and inter-modulation distortion analyzer. Simply connect the oscillator output to the input of the test unit, and hook the unit's output to the input of the analyzer. One quick set up, then switch a single control to simultaneously adjust input and output levels. Take up to ten power level measurements in 5db steps in just 60 seconds! Readings over a wide span of output levels fully describe the distortion characteristics of the test unit.

The IMA itself has a guaranteed residual IMD of less than 0.005% (typically under 0.003%). There are seven IM ranges with accuracy assured to within 5% of full scale (+0.005% on the 0.1 full scale range).

As all other TECRON laboratory instruments, the IMA is of advanced design, ruggedly constructed from highest quality components by skilled American craftsmen.

Product literature is free upon request. For a technical discussion on the advantages of using IM testing to detect audible distortion, send 25¢ for A.E.S. Preprint No. 871(B-9) to Crown International, Box 1000, Elkhart, Indiana, 46514, U.S.A.

Full input and output metering; also full input and output monitoring oscilloscope terminals ■ solid state construction, utilizing FETs for stability and compact size (7" x 19" x 7") ■ full complement of level controls ■ two internal oscillators eliminate the need for additional test equipment ■ rack mount list price \$570, with walnut cabinet \$595

Made Only in America

## TECRON



Circle 15 on reader service card

# equipment report

## Radatron Auto Sentry Educational Burglar Alarm Kit



Circle 30 on reader service card

RADATRON CORPORATION PRODUCES AN automobile burglar alarm aptly tagged the Auto Sentry Educational Kit. It intermittently blows the horn when triggered by operating any of the car's electrical equipment. In the past we have warned that some kits are definitely not for beginners due to inadequate instructions or the high degree of skill required. This one is specifically recommended for beginners because of its ease of construction and instructive nature. It does give protection but should not be expected to foil a professional car thief familiar with this type of alarm.

Guided by a well-prepared 52-page booklet, the builder is given background information about electronic components and soldering techniques. It is complete with a "What did you learn?" quiz at the end. The manual is amply illustrated with numerous views of the printed-circuit board and the rear panel with its power transistor relay driver. Radatron points out that some vehicles do not use a horn relay and offers one as an option. Horn circuit color coding for popular car models is included. There are five push buttons, the single printed-circuit board and the power transistor to be assembled, and construction time is only 2 to 3 hours. Resistors are preformed and wires cut to length with connectors eventually used to attach to the car's wiring without any cutting.

There is a troubleshooting list

limited mostly to suggesting incorrect component insertion. One omission in the booklet is the marking of component values on the schematic. The information, however, is readily available in the parts list and can be filled in. A neat small cast-aluminum enclosure houses the project. It can be easily mounted out of sight for further security. The five coded push buttons are mounted in die formation on the front panel along with a green hold indicator lamp.

The kit worked on completion but instead of the specified alternating 15 second on, 15 second off horn blast, the timing was 5 seconds on with 20 seconds off. The discrepancy is probably due to the wide electrolytic capacitor tolerances.

Operation is broken down into three modes; armed, temporary hold and permanent hold. The correct button choice puts the alarm into the temporary hold mode after turning on the ignition. Pressing the wrong button blows the horn. Turning off the ignition terminates this mode automatically arming the alarm. A 25-second delay gives time to leave the car. While armed, any voltage transient on the auto's 12-volt battery bus caused by operating any electrical equipment including the door light or brake light switches, triggers an SCR into conduction. The alarm is delayed for 15 seconds to give the owner time to open the door and key-in the temporary hold sequence. A different button combination selects the permanent-hold mode disabling the alarm until further programmed, allowing a parking lot attendant to drive the car without alarm activation.

The armed standby current drain was measured at 12-mA while the permanent-hold mode drain was 130-mA. A 24-hour "permanent" hold should be considered a maximum since this represents 0.13 x 24 or a 3.12 ampere-hour battery drain.

The Auto Sentry is a simple kit to construct well suited for the beginner, with the finished product offering a modicum of protection. Any gal who services her own Maverick will find this kit a cinch.

R-E

# THE MITS 1200 SERIES... "AT HOME-OFFICE-SCHOOL" & "ON THE MOVE" CALCULATORS!

THE 1200 SERIES - 12-DIGIT CAPACITY CALCULATORS

ADD ... SUBTRACT ... MULTIPLY ... DIVIDE INSTANTLY & ELECTRONICALLY!

At a price most everyone can afford ... Students, housewives and businessmen alike can now have at their fingertips the newest products of solid-state integrated circuit (IC) technology.

- FIGURE ...
- BUDGETS
  - INCOME TAXES
  - PERCENTAGES
  - GROCERY LISTS
  - CREDIT CARD STATEMENTS
  - MONTHLY STATEMENTS

## 1200 SERIES POCKET CALCULATORS FOR "ON-THE-MOVE" APPLICATIONS!



3 MODELS ALL WITH 12-DIGIT CAPACITY!

The 1212 displays 12 digits ... up to Nine Billion, Nine Hundred Ninety Nine Million, Nine Hundred Ninety Nine Thousand, Nine Hundred Ninety Nine, point Nine Nine. Great where "desk model capacity" is desired.

The 1209 displays 9 digits for more complex at home use or for many office applications.

The 1206 displays 6 digits, sufficient for student and most home uses. These "Pocket miracles" are all 100% American made featuring bright LED display, raised keys, leading zero suppression, fixed decimal output, true credit balance sign display, chain and mixed operation, automatic display cut-off, clear and clear entry keys. Battery life is exceptional, up to sixty hours operating time.

### PRICES

- |                     |                                  |
|---------------------|----------------------------------|
| 1206<br>(6 digits)  | Assembled \$59.95<br>Kit \$49.95 |
| 1209<br>(9 digits)  | Assembled \$79.95<br>Kit \$69.95 |
| 1212<br>(12 digits) | Assembled \$99.95<br>Kit \$89.95 |

SIZE: 5 1/4" H x 3 3/4" W x 1 1/2" D  
Hi-impact ABS case

High quality leatherette carrying case ... \$5.95

**AC ADAPTER** Equips any MITS 1200 series pocket calculator for operation from 110 VAC ... \$6.95

Use Your BankAmericard or Master Charge

**mits**® **micro Instrumentation & Telemetry Systems, Inc.**

5404 Coal Ave., S. E., Albuquerque, New Mexico 87108  
505/265-7553

WRITE OR MAIL COUPON FOR  
ADDITIONAL INFORMATION:



## 1230

**DESK CALCULATOR.** Our newest 4-function 12-digit desk calculator with Sperry gas discharge displays includes the features of the 1200 pocket calculator in an attractive desktop cabinet. Use it anywhere - in the home, at school or in the office - wherever 110 VAC is available.

1230 KIT: \$89.95

ASSEMBLED: \$99.95

## THE 1240 DESK CALCULATOR WITH AN INDEPENDENT MEMORY

In addition to the many 1230 features, the 1240 has a memory register with 4 separate controls ... it can be added to, subtracted from, recalled to the display or cleared without clearing the calculator. The fixed decimal can be set anywhere from 0 to 5 places. With these features, in Kit form or Assembled, the 1240's price is unbeatable!

1240 KIT: \$119.95

ASSEMBLED: \$149.95

1230/1240 Padded leatherette or rigid vinyl carrying case ... \$9.95

OTHER MITS PRODUCTS AVAILABLE:

- 1440 - SQUARE ROOT CALCULATOR  
Assembled \$249.95 Kit \$199.95
- DC4 • DC6 - DIGITAL CLOCKS  
Prices Starting at \$39.50

ENCLOSED IS CHECK  KIT  
FOR MODEL # \_\_\_\_\_  ASSEMBLED

AMOUNT OF CHECK \$ \_\_\_\_\_

Include \$5.00 for postage and handling.

Please send information on entire MITS line.

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_

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

Circle 16 on reader service card

# Great careers



## Join the high-paid electronics technicians who got their start through NTS Home Training.

Your home can become your own private classroom-workshop. NTS sends you everything you need to learn valuable technical skills in electronics. You get easy-to-grasp lessons, comprehensive kit manuals, large fold-out charts, and more. Plus the finest professional equipment available today. It's all included in your tuition, yours to keep.

You'll work with commercially-designed equipment, and school training material. Cash in on the tremendous opportunities in the expanding, exciting world of electronics.

If your field is television, you might decide to join a first-class TV repair center. Or start a shop of your own. Or specialize in industrial applications of television. Once you master an area of electronics, the direction you take is really up to you. And you'll be able to use the test instruments you built yourself.

It all begins at home, with NTS Project Method Training. Check card or coupon today for free full-color NTS Catalog and complete details. No obligation. No salesman will call.

### NTS COLOR AND B&W TV SERVICING

Build the largest most advanced color TV made! It's a Heath! Over-all solid-state design, 315 sq. in. ultra-rectangular screen, 24 channel detent UHF/VHF power tuning, matrix picture tube, built-in self-servicing features, "Instant On," A.F.T., solid-state VHF tuner, and much more! This is a commercial set, the kind you'll encounter in the field — and not for training purposes only. Also build and keep AM-SW Radio, Solid-State Radio, FET Volt-Ohmmeter, and Electronic Tube Tester. Learn trouble-shooting, stereo multiplex systems, radio, color and B&W TV servicing.

**Solid-state B&W TV**  
74 sq. in. picture (cabinet included)



Learn advanced solid-state circuitry as you build this B&W TV receiver. Course covers the full range of home entertainment electronics.

### NTS AUDIO ELECTRONICS SERVICING



**Solid-state Heath Stereo Receiver and Speakers**

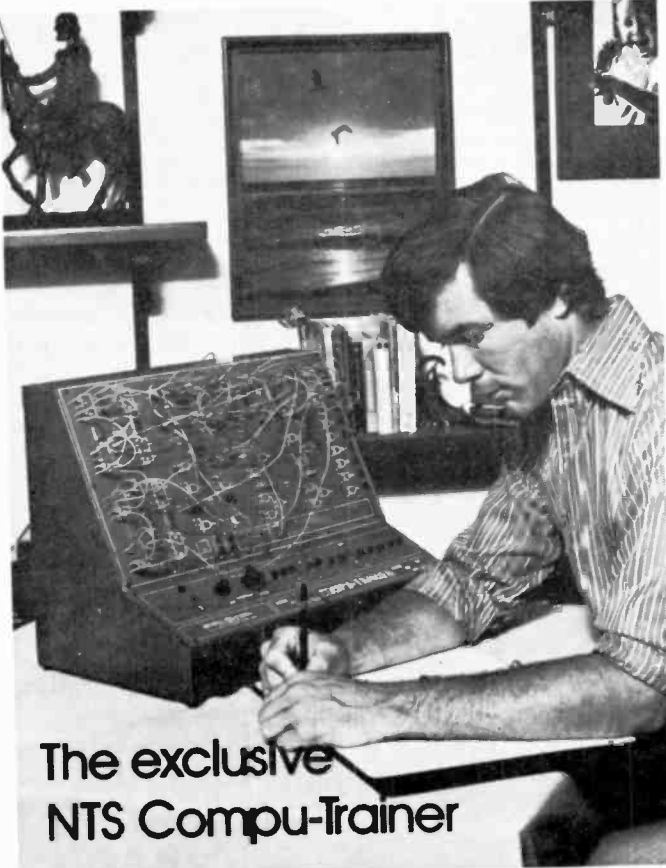
Learn sound theory — how it works in home radio, 4-channel, and more! Set up a spectacular music system. Learn about sound distortion, amplification and control, loud-speaker baffles, problems of system installation, etc. Included is Volt-Ohmmeter, In-Circuit Transistor Tester and solid-state Radio. Prepare yourself for great opportunities in the Home Entertainment Industry!



# begin at home.



New solid-state  
315 sq. in. color TV



The exclusive  
NTS Compu-Trainer

## NTS COMPUTER ELECTRONICS

Build and operate the exclusive NTS Compu-Trainer! Loaded with integrated circuits, it teaches you the how, what, and why of computers — faster, more thoroughly. You perform all wiring and patch-cording. No shortcuts! No pre-wired circuit boards. Also receive an FET Volt-Ohmmeter and a 5" wide-band Solid State Oscilloscope.

## NTS ELECTRONIC COMMUNICATIONS

Gain the prestige and earning power of owning an FCC First Class Radio Telephone License! Two exciting courses in the fields of transmitting and receiving. Experiment with an amateur phone 6-meter VHF transceiver, NTS exclusive 6-transistor solid-state radio and a fully transistorized volt-ohmmeter.

5-watt AM  
transmitter/  
receiver.



## NTS AUTOMATION/ INDUSTRIAL ELECTRONICS

Systems automation is the future of the industry — and you can play an important role! Enter the age of electronic controls by training on the NTS Electro-Lab — a complete workshop. Also receive a Solid State 5" wide-band professionally rated Oscilloscope. Build five industrial controls to regulate motor speed, temperatures, pressure, liquid level and much more.

5" Solid State  
Oscilloscope



## CLASSROOM TRAINING AT LOS ANGELES

You can take classroom training at Los Angeles in sunny Southern California. NTS occupies a city block with over a million dollars in facilities devoted exclusively to technical training. Check box in coupon.

## APPROVED FOR VETERANS

Accredited Member: National Association of Trade and Technical Schools; National Home Study Council.

## NATIONAL TECHNICAL SCHOOLS

Resident & Home Study Schools  
World-Wide Training Since 1905  
4000 S. Figueroa St., Los Angeles, CA 90037

Please rush Free Color Catalog and Sample Lesson, plus information on course checked below. No obligation. No salesman will call.



### National Technical Schools

Resident & Home Study Schools  
World-Wide Training Since 1905  
4000 S. Figueroa St., Los Angeles, CA 90037

- Master Course in Color TV Servicing (For Advanced Technicians)
- Master Course in B&W TV & Radio Servicing
- Master Course in Electronic Communications
- Practical Radio Servicing
- FCC License Course
- Master Course in Electronics Technology
- Automation & Industrial Electronics
- Computer Electronics Dept. 206-033
- Basic Electronics
- Audio Electronics Servicing

Name \_\_\_\_\_ Age \_\_\_\_\_

Address \_\_\_\_\_

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

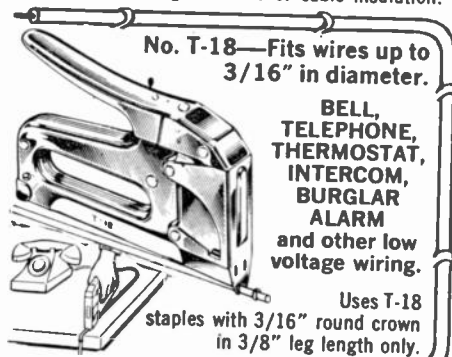
- Check if interested in Veteran Training under new G.I. bill.
- Check if interested ONLY in Classroom Training at Los Angeles.

# ARROW AUTOMATIC STAPLE GUNS

## CUT WIRE & CABLE INSTALLATION COSTS

... without cutting into insulation!

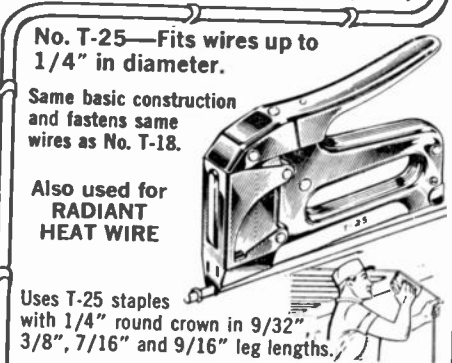
**SAFE!** Grooved Guide positions wire for proper staple envelopment! Grooved Driving Blade stops staple at right depth of penetration to prevent cutting into wire or cable insulation!



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" leg length only.



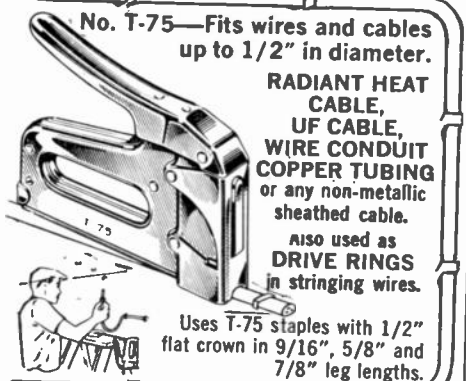
No. T-25—Fits wires up to 1/4" in diameter.

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.

T-18 and T-25 staples also available in Monel and with beige, brown and ivory finish at extra cost.



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 Automatic Staple Guns save 70% in time and effort on every type of wire or cable fastening job. Arrow staples are specially designed with divergent-pointed legs for easier driving and rosin-coated for greater holding power! All-steel construction and high-carbon hardened steel working parts are your assurance of maximum long-life service and trouble-free performance.

Ask your Electrical Supply Dealer or write for further details.

ARROW FASTENER COMPANY, INC.  
Saddle Brook, New Jersey 07663  
"Pioneers and Pacesetters  
For Almost A Half Century"

# appliance clinic

## ALL ABOUT TIMERS

by JACK DARR  
SERVICE EDITOR

THE "CONTROL-CENTER" OF ANY automatic electrical appliance that offers multiple functions is the timer. Each "thing" must be turned on and off at the proper point in the cycle. In an automatic washer, for instance, this would include water valves, the motor, drain pump, clutches for changing speed from wash to spin, and even the timer driving motor itself. When it reaches the end of the cycle, it turns itself off.

If you have troubles in any machine like this, the first thing to do is to isolate the function that *isn't* working. For example, the hot-water valve. A symptom here would be cold water in the tub after the timer has gone through the WASH position. If the machine has a TEMPERATURE selector switch, HOT and WARM, this would be set to WARM for the cold-water-in-the-tub symptom. If the selector switch was set to HOT, the symptom would probably be "no-water-at all" since only the HOT valve opens then. (First step; check to make sure that the hot water faucet is turned on.)

Check the wiring diagram on the back of the machine, and locate the hot-water solenoid. (Follow the hoses.) There are several ways of checking this. Pull the ac plug, and pull one wire from the solenoid. Most of these have push-on connectors. Check the coil for continuity with an ohmmeter. If this is good, follow the wiring up to the timer. It may go through the HOT-WARM selector switch; some of these control only the cold water solenoid, however.

Most machines have very plainly color-coded wiring. Follow the hot-water valve lead to the contacts on the timer. Be sure that all of the push-on connectors are firmly seated. Wiring troubles are comparatively rare, but check for them just the same.

Next you can turn the timer knob to the beginning of the WASH portion of the cycle. The hot-water valve should be open, filling the tub. Check across the timer contacts with the ohmmeter.

A better test for contacts is to clip the ac voltmeter across them (in-

sulated clips *please!*), and then plug the machine in. With the contacts open, you will normally read the full line voltage across them, (unless another switch somewhere in the circuit is open). However, when the contacts should be closed, there should be absolutely *no* voltage drop across them. If you see a low ac voltage reading, this indicates that the contacts are dirty. You're reading the drop across the resistance of the "dirt".

This means trouble. The resistance of the poor contact generates heat, the heat burns the contacts even more, and you're in a vicious circle. In a great many of these timers, the contacts are easy to get at. Fig. 1 shows a typical timer assembly. You can clean up the contacts with a "point-file", fine sandpaper or even an emery-board. Smooth them off to a high polish, for best contact.

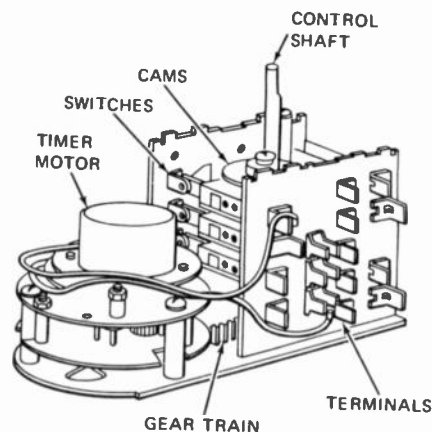


FIG. 1—TYPICAL TIMER ASSEMBLY, with motor and contacts.

Turn the timer knob by hand, to open and close the contacts. Check to make sure that the contacts meet absolutely flat, or parallel, for maximum contact area. If necessary, bend the contacts arms very slightly so that they do meet properly. Contact closure should be "firm", so that the arm bends just a tiny bit, to jam the contacts tightly together. Fig. 2 shows how this type of cam and lever actuator works. As you can see here, some of them use spdt switches. Be sure

(continued on page 102)

# Leader

gives you  
more than a  
two year  
warranty

**There's a free gift waiting for you at your Leader distributor.**

Get to know the Leader quality line, first hand, from your distributor... and we'll give you more to remember us by! Learn about our unprecedented two year warranty that applies to all Leader test instruments. Discover the precision, the dependability, and the over-all product excellence we've been telling you about. What's more, you'll get the straight facts about the better-than-competitive pricing and the real value that can be yours with Leader. The free gift? Your distributor is waiting for you to ask!

**"Put us to the test!"**

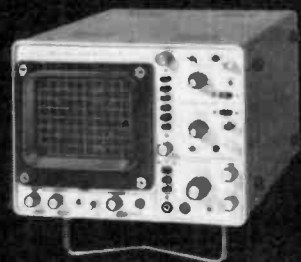
**Leader**

INSTRUMENTS CORP.

37 - 27 Twenty-Seventh Street,

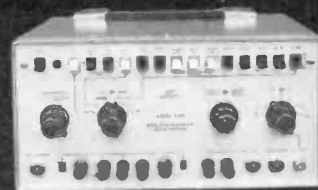
Long Island City, N.Y. 11101

(212) 729-7410



**LBO-505-5' DUAL CHANNEL  
DUAL TRACE TRIGGERED SCOPE**

Outduels them all! You'll use it to compare, control and troubleshoot color, B & W, audio and more. You'll check gain, loss, distortion, phase shift and frequency. It provides separate or simultaneous display of CH. 1 & 2 alternate, chopped, added algebraically and vector (x-y). It also offers triggered and recurrent (automatic) sweep; plus AC or DC coupling each channel. It's the best, most practical scope you can own. See your Leader distributor, he'll give you the entire Leader story; probes included. **\$559.95**



**LSW-330  
POST INJECTION  
SWEEP-MARKER GENERATOR.**

An unparalleled, easy-to-use Leader for color TV service and testing. Offers all sweep and marker signals for circuit alignment of video and sound IF's; and chroma. It's accurate, stable and rugged; has automatic limit control for constant amplitude and a 10.7MHz sweep to extend use into FM-IF. Solid state, compact, it's another great Leader timesaver! **\$409.95**

ALSO AVAILABLE:

**LSG-221-FM MULTIPLEX/STEREO  
GENERATOR.**

Check balance, separation and alignment of Multiplex receivers and tuners with stability that's unequalled anywhere. So precise and accurate, you may not even want to use a scope! Audio signal frequency is  $\pm 1\%$  accuracy at 1KHz. Signal separation is 50dB; with output voltage at 0 to 3Vrms, cont. variable. For bench, field or lab work. **\$229.95**

# HERE IS THE WORLD'S ENTIRE SELECTION OF AUTOMATIC TURNTABLES WITH ZERO TRACKING ERROR.

There they are. All one of them. Garrard's Zero 100, the only automatic turntable with Zero Tracking Error.

Not that there haven't been attempts by other turntable makers. Many have tried. This is the first to succeed. And it has succeeded brilliantly. Expert reviewers say it's the first time they've been able to hear the difference in the performance of a record player...that the Zero 100 actually sounds better.

It's all because of a simple but superbly engineered tone arm. An articulating auxiliary arm, with critically precise pivots, makes a continuous adjustment of the cartridge angle as it moves

from the outside grooves toward the center of the record.

This keeps the stylus at a 90° tangent to the grooves. Consequently tracking error is reduced to virtual zero. (Independent test labs have found the test instruments they use are incapable of measuring the tracking error of the Zero 100.) Theoretical calculations of the Zero 100's tracking error indicate that it is as low as 1/160 that of conventional tone arms.

Zero tracking error may be the most dramatic aspect of Zero 100, but it has other features of genuine value and significance. Variable speed control; illuminated strobe; magnetic anti-skating;

viscous-damped cueing; 15° vertical tracking adjustment; the patented Garrard Synchro-Lab synchronous motor; and exclusive two-point record support in automatic play.

The reviewers have done exhaustive reports on Zero 100. We believe they are worth reading, so we'd be happy to send them to you along with a 12-page brochure on the Zero 100. Write to us at: British Industries Co., Dept.C243Westbury, N.Y. 11590.

**GARRARD  
ZERO 100**

**\$199<sup>95</sup>**

less base and cartridge





# 4-CHANNEL MATRIX

## How Good Is It?

*It sounds better than 2-channel stereo and appears to be getting better all the time*

by EUGENE WALTERS

YOU DON'T HAVE TO ASK THE EXPERTS any more; ask anyone at all who's heard four-channel stereo and you'll find that he agrees with the experts' consensus—4-channel sound is in, and it's already here in a big way.

Just take a quick look at the incredible equipment lineup. Everyone who makes any kind of stereo equipment at all has at least one quadraphonic product in the line; more likely, it's three or four items or more. These products can run from the simple kit-type matrix decoders for \$19.95 on up to a super combination AM/FM Stereo/4-Channel Receiver/Amplifier with every bell and whistle you can think of and a few that may not have occurred to you yet.

But the all-important question is, "What's in that little decoder box or behind the decoder selector switch on the big rig?" There has been a variety

of equipment designs, announcements, pronouncements, technical papers purporting to prove something or other, and massive confusion for everyone. There are two basic formats for 4-channel sound today: discrete 4-channel tape, and 4-channel records. The records can be further broken down into the so-called "discrete" discs (the RCA/JVC system) and the various matrix types.

Let's take a look at the RCA/JVC disc first. While we won't offer any kind of final judgment here, the "discrete disc" just might not end up as the industry standard, even though it does produce an exceptional four-channel effect with the right equipment and under the right conditions. But that's precisely the rub with the carrier-type disc; it requires too much in equipment modifications, special pickups, styli, and cannot be broadcast on FM without some special

ruling by the FCC—which may be hard to come by.

So if we rule out the carrier-type disc, we are left with matrix, and the one thing we can say for sure about matrix 4-channel is that it's getting better all the time. The beauty of the matrix is its operational simplicity. No special pickups are needed; no fancy detecting circuitry; and any FM stereo broadcaster can convert to quadraphonic by simply playing an encoded record on the air!

For a while, there was a field of three different competing matrix systems: Columbia/Sony's SQ; Sansui's QS; and the Electro-Voice System. There were also various schemes advanced by some manufacturers for "recovering" the ambience information that is believed to be present in most recent two-channel stereo recordings. This is done by extracting certain phase differences and feeding these

## on the cover

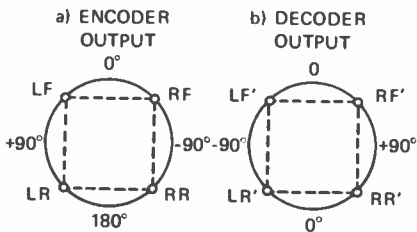
Discrete 4-channel records are not only possible, but they *are* being made today. One of the current group of discrete 4-channel systems is shown on this month's cover. It consists of a JVC model 4DD-5 Disc Demodulator, a special high-frequency-response JVC phono cartridge (its got a conical stylus and frequency response out to 38,000 Hz); and of course, the records to play using this system. The record shown is an RCA Quadradisc. Others are available now, as are a variety of records from JVC. These recordings are not compatible with matrix records. Other 4-channel discrete disc equipment is being produced by JVC, and also by Panasonic. There are more demodulators, as well as preamp-amplifiers and receivers with the discrete 4-channel demodulator built in.

How good is discrete 4-channel? We don't know at this time, but tests are being performed now to enable us to give you some basis of comparison between 4-channel matrix and 4-channel discrete. R-E



signals, mixed with some of the up-front signal, to one or two rear speakers. To be sure, this technique very markedly enhances the overall sound

**PHASE RELATIONSHIP BETWEEN CHANNELS**



**PHASE RELATIONSHIPS** between the four channels in both encoding and decoding.

quality and listening experience for two-channel stereo recordings—much the same way that a mono recording can be enhanced by playing it through a stereo system.

But even here, the sound improvement is markedly better for one very important reason: we have transposed the reproducing system from a “wall of sound” to a “room full of sound”—creating the “sound field” which has come to be synonymous with four-channel.

In the process of creating such a sound field, some front-to-back crosstalk is inevitable. For that matter, isn't such “crosstalk” inevitable in the live concert-hall situation? We don't sit at a concert and try to measure the reverberation time of a particular pillar or balustrade; instead we are immersed in the total sound field, and if the hall acoustics are as good as they should be, our attention is focused on the source of the sound—up front, on the stage.

What all this boils down to is a new study and approach to the psychoacoustic aspects of sound reproduction—how we listen to and hear live sounds and their recorded versions. Increasingly, matrix researchers have come to rely on these psychoacoustic phenomena in an effort to squeeze more separation out of their respective systems.

We know how good a matrix can sound. The reason why it has been so difficult to get the matrix systems to provide discrete effects can be seen in this basic encoding formula:

$$L = (LF + LR)\cos\theta + (RF - RR)\sin\theta$$

$$R = (RF + RR)\cos\theta + (LF - LR)\sin\theta$$

These two equations represent the output of a typical matrix encoder—the actual signals that will go into the disc-cutting head.

But what has happened here? We have taken four “unknowns”—the four signal channels, LF, LR, RF and RR and reduced them to two equations so they can be cut in the disc as simply

L and R. When it comes time to recover these four individual signals, we still have just two equations, and no amount of algebraic or electronic processing will extract more than two unknowns from two equations.

Yet *something* is extracted by the decoder working on the signal from that record. The decoder output in a basic matrix system looks something like this:

$$LF' = L\cos\theta + R\sin\theta = LF + 2RF\sin\theta\cos\theta + LR\cos2\theta$$

$$RF' = R\cos\theta + L\sin\theta = RF + 2LF\sin\theta\cos\theta + RR\cos2\theta$$

$$RR' = R\cos\theta - L\sin\theta = RR - 2LR\sin\theta\cos\theta + RF\cos2\theta$$

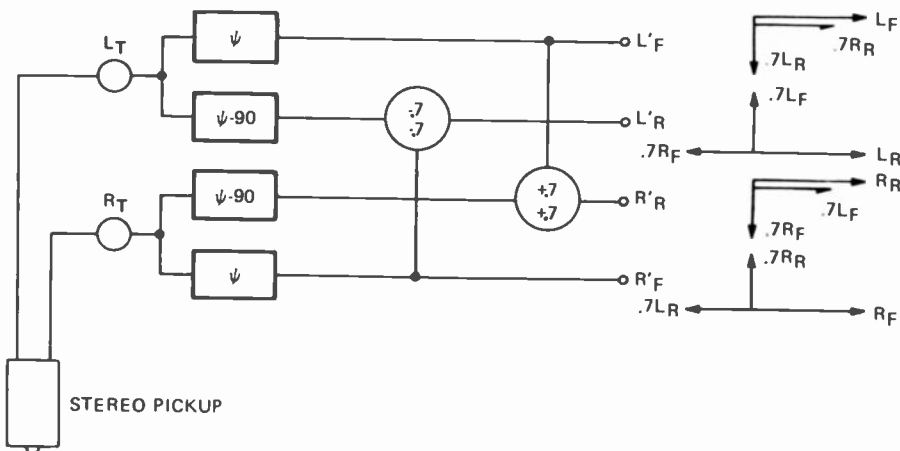
$$LR' = L\cos\theta - R\sin\theta = LR - 2RR\sin\theta\cos\theta + LF\cos2\theta$$

So it is possible to end up with some usable signal. What has happened is that the front-to-back separation has

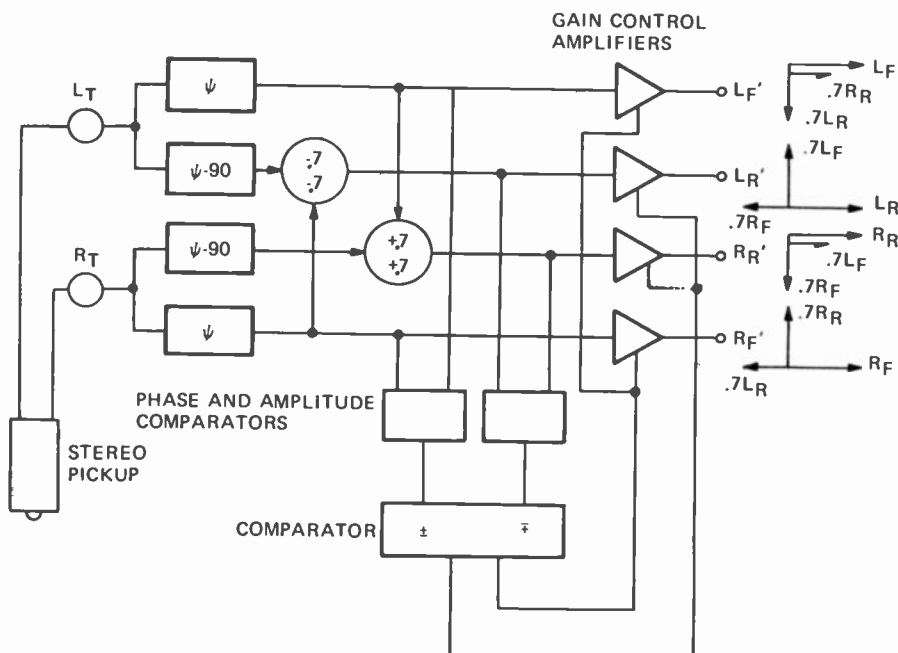
been reduced—diluted in the process of condensing and then recovering the four channels. Instead of decoding into LF, RF, RR and LR, the decoder output is something slightly different: LF', RF', RR' and LR'. Yet even these diluted channels can provide a degree of listening satisfaction unobtainable with conventional two-channel stereo.

But from the vantage point of ever-improving technology, it's quite reasonable for us to be a little unsatisfied with this sort of compromise. Something better was needed. In the past year, several important developments have made the matrix record look more and more attractive. For one thing, Electro-Voice combined its system with the not-dissimilar SQ matrix. That left two major matrix contenders: CBS SQ and Sansui QS.

The principal differences between these two systems in their basic form



**FOLLOW THE SIGNAL FROM THE STEREO PHONO CARTRIDGE**, through the decoder to the decoder output and this is the relationship between signals using an SQ decoder.



**SQ MATRIX DECODER WITH LOGIC** is shown here in block diagram form. Signal vectors produced when matrix signal is processed by this circuit are on the right.

involve the method of phase-shifting the rear channels before recording. Sansui points out a major problem with the rear channels as processed in the SQ system: the 180° phase shift used in SQ can cause severe rear-channel cancellation when the actual disc is cut. This is caused by the mechanical lineup of various vectors in the groove walls.

To get around this problem, the QS system phase shifts the left-rear channel by +90° and the right-rear channel by -90°. The total effect is 180° of separation between LR and RR but apparently without the phase cancellation that plagued other matrix systems.

This was fine as far as it went, but it soon became obvious to everyone that something had to be done to improve channel separation. As long as there were just two equations and four unknowns, accurate recovery and a high degree of separation seemed impossible.

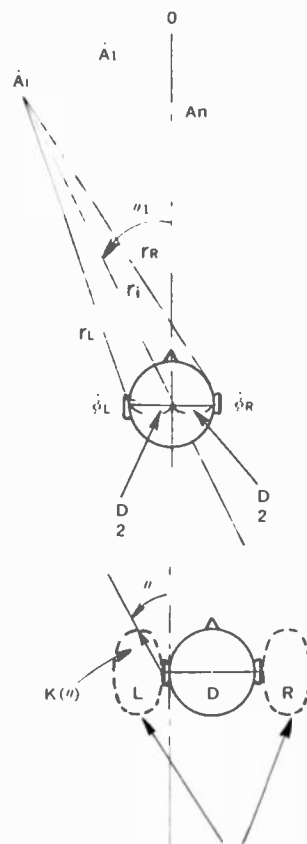
Back to psychoacoustics. If this word has left a bad taste in your mouth because of some of the early attempts to make quadrasonic

records, it's certainly understandable. After all, the Scheiber psychoacoustic system looked good on the blackboard, but sounded barely like 2½ channels of stereo. Then many experts swung over to discrete, while others decided to try different types of matrix encoding. Now the experts are saying that maybe Scheiber had something after all.

The basic matrix methods went about as far as they could a year or so ago. To obtain the added separation, something else was needed. If we go back to the basic definition of "high fidelity," we find that it is not a close or precise reproduction of the original sound at all. Instead it is a method of creating an acceptable *illusion* of the original sound or a kind of sound that will be agreeable to the listener—with little or no pretense of being faithful to the original. True, refinements in reproducing technology have brought us ever closer to the original, but stereo and quadraphonics are still just an *illusion*.

Psychoacoustics tells us this about directional perception in a sound field: directionality is perceived by

phase, precedence and relative amplitude. A simple experiment will show that the ears hear differences of intensity (amplitude) as differences in

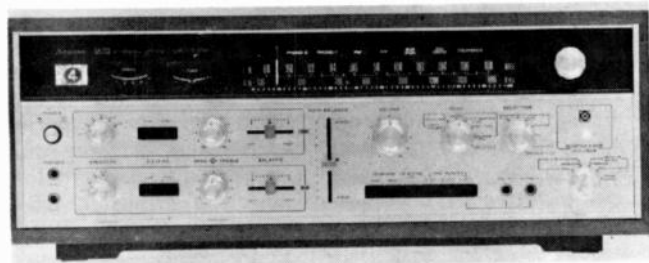


Directional Sensitivity of Ears

**DIRECTIONALITY** of a reproduced sound image is determined using calculations of this type.

phase and that actual differences in amplitude are perceived as differences in amplitude. But then differences in amplitude are still translated by our ears as phase differences, so the end result is the same—our ears,—the ultimate phase detectors, pinpoint directionality by phase differences.

But something else important was discovered both by CBS Labs and by Sansui researchers. Given any two identical sound sources, the one that is louder will mask directionality from the other. We perceive the louder source at the instant that it is louder than other sources. There is also the precedence effect—sound waves that arrive at the listener's ears first provide the needed phase relationship for directional perception. If, a few microseconds later, another sound source provides a louder signal, then directionality will shift toward *that* source. In effect, even though we may be using four sound sources in the quadrasonic listening room, our own perception of instantaneous directionality can accommodate only one of these speakers at a time—as long as one of these speakers is louder than the others. When amplitude is equal for all

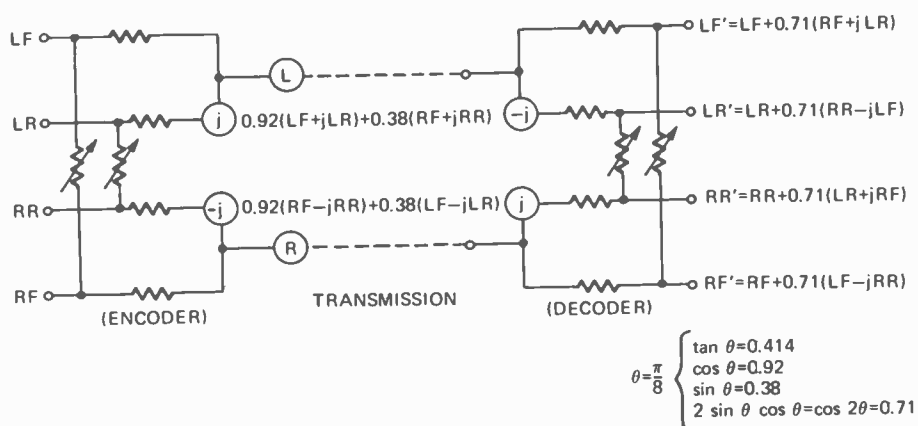


**SANSUI 4-channel receiver** is their model QRX-6500. Has several matrix decoding systems built in.

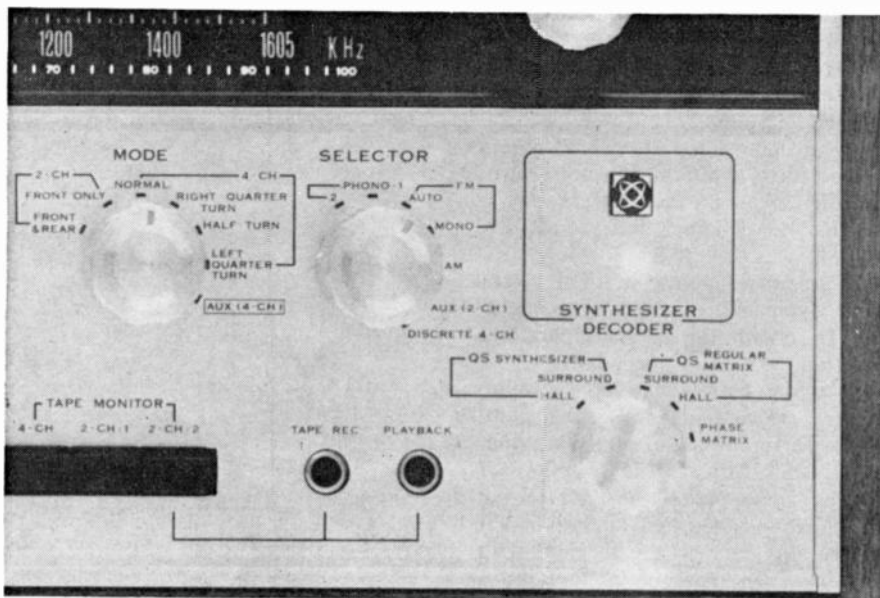


**ELECTRO-VOICE EVX-44 Universal Decoder** is said to decode any matrix recording.

**BLOCK DIAGRAM OF THE SANSUI QS CODING SYSTEM**



**SANSUI QS CODING SYSTEM** is shown in block diagram form. Mathematics of the system are written in as they apply.



WHAT THE USER SEES OF THE QS MATRIX is this portion of the receiver controls. The MODE, SELECTOR, and SYNTHESIZER DECODER knobs.

four speakers, then a total immersion in the sound field occurs, but this happens in theory or with a tone generator only—certainly not with real music.

To capitalize on this effect, CBS developed its gain-riding logic—a method of deceiving the ears into believing that they are hearing true directionality, when such directionality without the logic may be only minimal. The SQ logic is modulated by low-frequency signals, with logic gates in effect providing instantaneous switching of major audio signals among the four loudspeakers. The entire sonic system in effect picks up a particular kind of rhythm of its own. The gates provide essentially an infinite number of states from full on to full off, and by detecting small variations in the directional characteristics of the decoded signal, modulate volume level settings for a given speaker at any given time. The SQ logic will turn one speaker on at a higher level, while knocking the other three down.

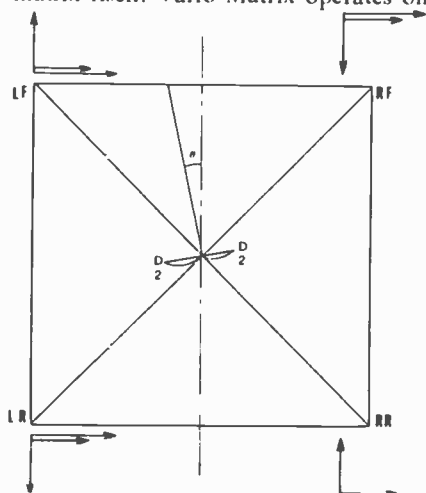
The total effect is one of enhanced directionality. Certainly minute differences in level have given way to much greater differences, so the directionality practically hits the listener over the head. Gain-riding logic works very well with one predominant direction of sound source. When there is more than one predominant source, the system tends to get confused, and become less and less effective. It is "fooled" into doing some things that it wouldn't ordinarily do. It can create images with sound coming from the sides or from the front, side and back simultaneously. The logic operates so fast that the listener can't hear it actually operating. This is a desirable feature, but the false images created by gain-riding logic can leave something to be desired in the listening ex-

perience. To be sure, gain-riding logic possesses a high degree of directionality, and from the standpoint of creating an *illusion*, can be very effective.

Hardware can be a problem, especially without any across-the-board controls. Lafayette Radio, for example, with its LRA-6000, has attempted to operate the SQ logic effectively. As compared with the Sony SQD-2000, the Lafayette unit has fewer components, and uses a simpler way of handling wave-comparative logic. Yet the specifications for this unit are impressive, and it does its intended job, up to a point.

But even the Sony unit is substantially different from the decoder designed by CBS Labs. Here, we find basic differences in time constants—how fast the logic works, and its total effect.

The Sansui *Vario-Matrix*, instead of using the go, no-go operation of logic, changes the parameters of the matrix itself. Vario-Matrix operates on



OUTPUT IN EACH CHANNEL as delivered by a rotationally symmetrical phase-amplitude matrix system for 4-channel sound.

changes in the phases and amplitude relationships of the matrix to provide the appearance of various sounds coming out of various places; it doesn't change the level, but it does change the phase/time relationships noticeably.

Since amplitude changes give the effect of phase changes, the Vario-Matrix sidesteps the level-juggling act entirely, and operates directly on the apparent phase relationships as they occur at the listener's ears. If, for example, a 1-kHz signal is fed to just the LF encoder input, there will be a separation of more than 20 dB among the four channels. As a signal is fed to another channel—such as a 3-kHz signal to the LR channel—and is increased in level to gradually acquire greater separation, it gradually begins to mask the directionality of the 1-kHz LF signal. As this happens, the need for great separation between the LF channel and the other three channels decreases, so the matrix in effect reduces the separation of the LF signal. When the LR signal finally reaches the same level as the LF, there is still a separation of about 10 dB front-to-back.

As the 3-kHz signal continues to increase in level, the LF separation becomes less needed and decreases while the LR separation continues to increase. While all this is going on, the low-level signal (LF) retains its total energy; it's not artificially decreased the way it would be with logic. In a logic matrix, the lower-level signal in the LF channel would no longer be reproduced at all, and only its crosstalk components would be carried in the other channels. This separation effect continues in force, even when two simultaneous signals are fed into the system.

Unfortunately, a lot of spade work still has to be done in our understanding of just how psychoacoustics operate in a real listening environment. Still, what little has been learned about the mechanics of how we perceive sound has already contributed toward vastly improved quadraphonic reproduction systems. The coming few months will see a major shaking-out of the matrix and discrete systems, and the industry may well settle down with a psychoacoustically viable system that works as well as discrete. In the meantime, eardrum tests have borne out the reality of enhanced matrices. The Sansui QS system, when A-B'd with discrete sources, showed little if any *apparent* differences between matrix and discrete. The best-trained ears in the industry came away from last Fall's AES convinced that this was the way to go. But as with all major developments, time (and phase) will tell. R-E





# BUILD 4-CHANNEL POWER AMPLIFIER

*Unbelievably low distortion is a feature of this four-channel amplifier for quadraphonic applications. Each channel drives an 8-ohm load at up to 60 watts rms.*

by DANIEL MEYER

TIGER .01 IS MY LATEST EFFORT TO PRODUCE A BETTER audio power amplifier. With this design, distortion is reduced to a level of less than .01% at any power level up to rated output. With distortion products pushed down to a level more than 80 dB below the program material, it is very tempting to announce that this is the ultimate and that no further improvement in amplifiers will ever again be necessary.

Since the same thing was said when amplifier distortion was reduced to 5%, then 1% and finally to 0.1% and each time has been proven false, we will simply have to await improvements in other components to a comparable level of distortion before we can know for sure, but don't take any bets. The ear has proven to be considerably more sensitive to such things than anyone imagined ten or twenty years ago.

Like most things, the *Tiger .01* circuit has evolved slowly over a number of years with small, but steady improvements. It is usually possible to consider a power amplifier as consisting of two parts; the input, or voltage amplifier portion and the output, or matching portion. The point of division is obvious in most circuits, since the portion following the bias system is the output portion.

Except for car radios and a few other low/power special cases almost all development effort has been toward perfecting the class AB, or B type circuits. Class-A circuits

are only practical for power outputs up to approximately 10 or 12 watts. Beyond this point the high quiescent power dissipation caused by low efficiency of class A-circuit discourages serious attempts at more powerful circuits.

The advantages of complementary class-AB and class-B amplifiers have been known for at least twenty years.<sup>1</sup> Most of the complementary circuits in use today are described in this paper. High-power complementary transistors were not available at this time though, and the few germanium npn types that could be obtained were terribly expensive. This led to wide use of quasi-complementary circuits in which only one polarity of output transistor is used with a complementary driver pair as in Fig. 1.

This type circuit presents a number of problems. First, the output stage must operate at unity gain, since (in the form shown here) the positive half cycle of the signal passes through a pair of emitter followers that cannot provide any gain. In addition, the circuit inherently has greater distortion than a complementary circuit due to the different number of junctions in the signal path on positive and negative half cycles and the difference in input impedance of the upper and lower pairs. Despite all of this, the quasi-complementary output circuit delivers reasonably good performance and is still widely used today.

Fully complementary output circuits became popular in the late '60s when reasonably priced complementary silicon transistors became available. Some of the best of these were the Marrantz 15 and the JBL "T" circuits. In 1967 the first of the present series, *Lil Tiger* was introduced. Although not designed to be the worlds lowest distortion amplifier, this circuit gave quite respectable performance at minimum cost, due to the use of complementary plastic output transistors. In October 1970 the *Universal Tiger*<sup>2</sup> introduced a new variation in output circuits, an output stage with gain; see Fig. 2. You will note that that type circuit is completely complementary and also cannot be built without complementary transistors in the output stage. Using this type of output circuit reduces the drive voltage needed for the output section of the amplifier and also makes it possible to control the response of the output section very neatly by proper choice of capacitor C in the schematic.

The *Tiger .01* uses a similar output circuit, but with a

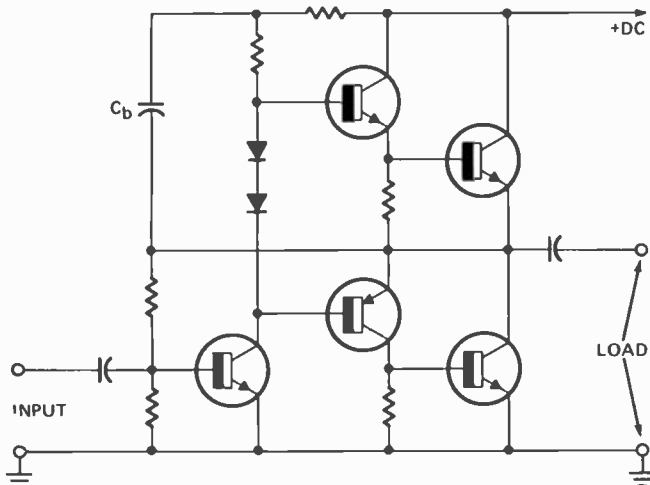


FIG. 1—QUASI-COMPLEMENTARY OUTPUT TRANSISTORS are driven by driver in complementary configuration.

1. G. C. Sziklai, "Symmetrical Properties of Transistors and Their Applications" Proceedings of the IRE, 41, 717-724 (1953)

2. "The Indestructible 125 Watt Power Amplifier." *Popular Electronics*, October, 1970

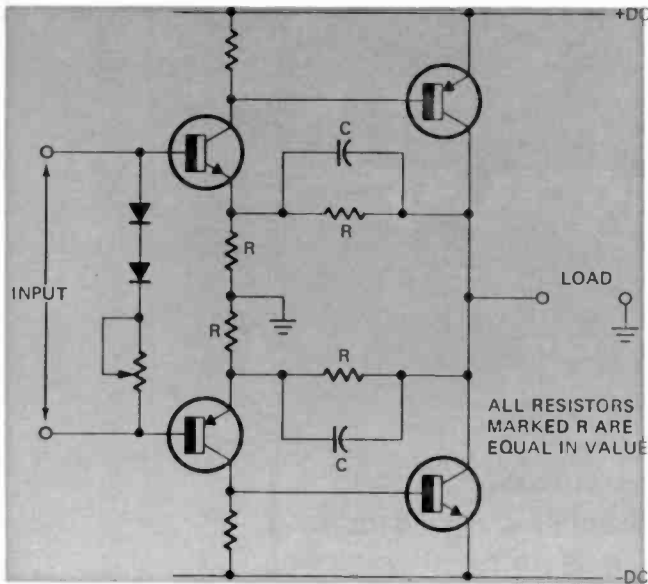


FIG. 2—OUTPUT STAGE WITH GAIN uses complementary transistors in circuit requiring relatively low drive voltage.

Darlington output; thereby making the output section of the circuit a triple. Doing this increases the current gain of the output section of the amplifier and further reduces the amount of drive current needed from the amplifier portion of the circuit. From this we get greatly reduced gain variation with signal output and can almost eliminate any need for matching of the complementary transistors.

The only problem with a triple is that temperature tracking of the bias and output stage is far more critical now. Feedback from current sensing resistors R37 and R38 to the first stage of the triple, Q10 and Q11, along with thermal compensation diode D4 takes care of this problem. Output feedback resistors R28 through R31 set the gain of the output triples at approximately three, so we have a very linear output section for our amplifier that only requires around 8 volts rms and a few milliamps to drive it to full output.

With the output section of the amplifier taken care of, the voltage amplifier portion can be considered. Most early power amplifiers and even a few current ones, used single-stage voltage amplifier and driver systems with a bootstrap collector load of the type shown in Fig. 1. Sometimes an additional impedance matching stage was added at the input to allow matching to tube preamps. Capacitor C<sub>b</sub> allowed the amplifier to produce full positive supply output on signal peaks by adding the output voltage to the supply voltage at the junction of the two collector resistors. This type voltage amplifier does not lend itself to use with split power supplies and it is generally used with a single-ended power supply. Due to the half-supply voltage offset at the output the speaker must be coupled through a large capacitor.

This system normally has 20 some odd dB of negative feedback and will produce an amplifier with less than 1% distortion. The circuit can be improved and the amplifier can be used with a split supply, if the input stage is made a differential amplifier. This allows the input and feedback points at the two bases both to be referenced to ground and keeps the output point at dc ground. This is a considerable improvement since there are now two stages of gain, which allows more feedback to be used to lower distortion and the speaker now has no reactive components between it and the output of the amplifier. The entire amplifier may now be dc coupled if desired.

Another improvement is the use of a current source as the driver collector load instead of the bootstrap capacitor, split resistor system. This considerably reduces any cross-

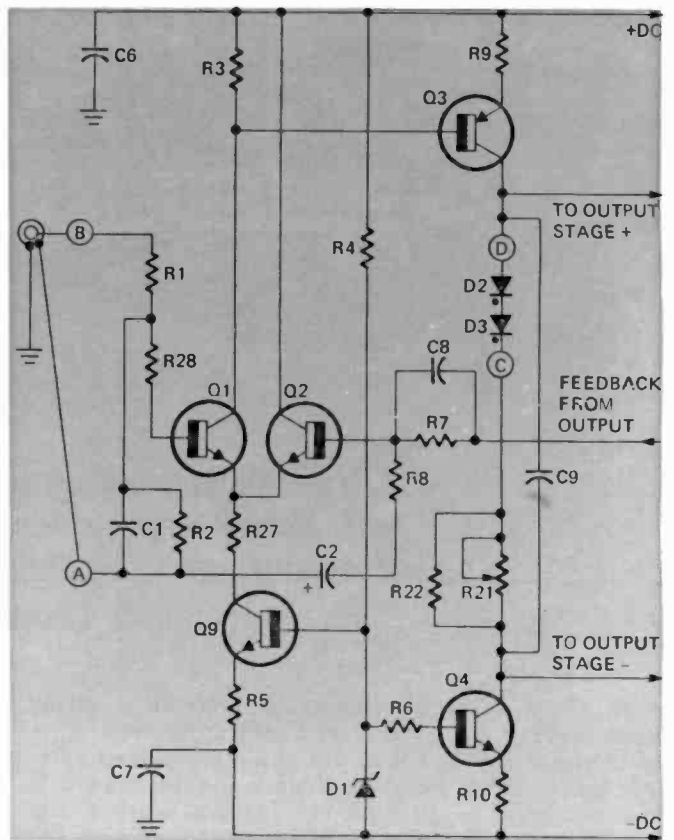


FIG. 3—CROSSOVER DISTORTION IS INHERENTLY LOW when current source replaces the driver bootstrap capacitor.

### SPECIFICATIONS

**Power Output**—60 watts sine wave continuous; 8-ohm load.

**Frequency Response**—5.0 to 100,000 Hz at -1.0 dB points.

**Distortion**—Less than .01% IM distortion up to rated output. See graphs for complete distortion information.

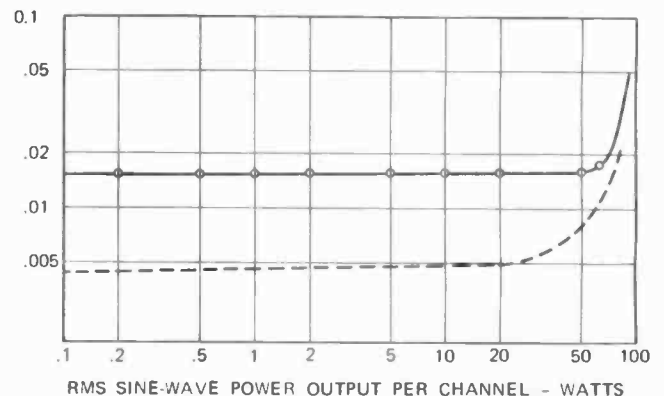
**Output Impedance**—Less than 0.1-ohm 20 to 20,000 Hz.

**Hum and Noise**—More than 80 dB below full output.

**Input Sensitivity**—0.8 volts rms maximum for full rated output. Level control provided to reduce sensitivity if needed.

**Stability**—Completely stable with any type load. Volt-Amp limiting provided to protect output stage from effects of very reactive load.

1 kHz TOTAL HARMONIC DISTORTION ———  
60/7000 Hz (4:1) IM DISTORTION - - - -



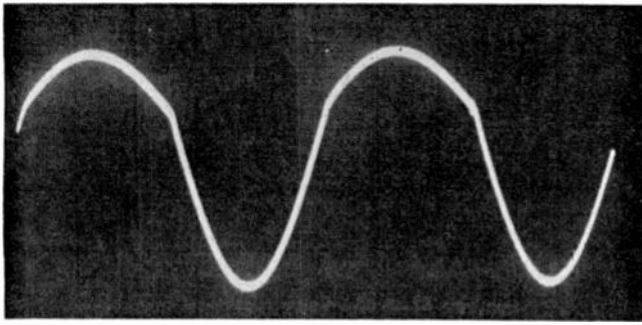


FIG. 4—DISTORTED WAVEFORM fed from collector of Q1 to the base of Q3. Effect of distortion is reduced by push-pull driver.

over notch distortion that may be present due to less than optimum bias conditions. This type driver causes the driving voltage to switch very quickly through any voltage levels where the driving current requirements drop or disappear. Although this type driver does not eliminate the need for bias in a quality amplifier, it makes the amount of bias used much less critical. In lower quality applications, such as PA work, the bias system may be removed and the amplifier run class B, generally without any noticeable effect on the quality. Amplifiers with these improvements can be expected to have distortion levels in the 0.1% range, and there should be no distortion peaks in the low power levels at the crossover point. Figure 3 is typical.

So at this point we have a pretty sophisticated amplifier with about all the gain we can handle without running into phase margin problems, or the necessity of reducing bandwidth drastically to keep the system stable. How do you improve on this circuit. A look at the oscilloscope photograph of Fig. 4 should give you a good idea. This is a photograph of the waveform at the collector of Q1 as seen

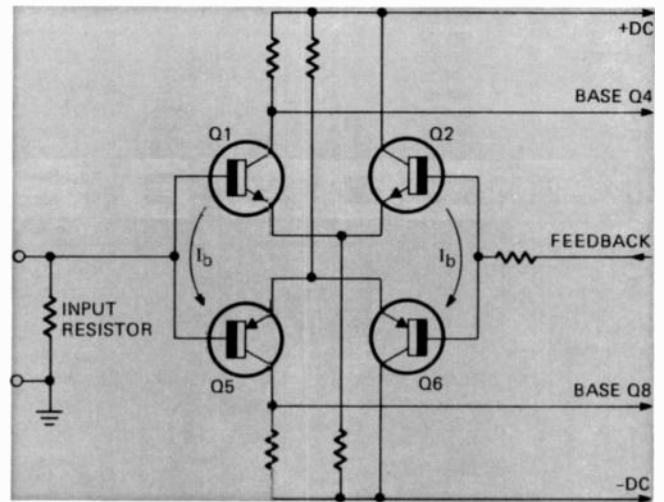


FIG. 5—COMPLEMENTARY DIFFERENTIAL INPUT STAGE. Several of its characteristics can be used to good advantage.

at base of Q3 point in the circuit of Fig. 3.

Why is this waveform so highly unsymmetrical you ask? Well the reason is quite simple. Q1 is supplying the current at this point to drive stage Q3. On positive half-cycles of the signal swing, Q3 must supply current to the driver in the upper half of the output section and also must supply the constant amount of current being soaked up by stage Q4. On negative half-cycles, however, the output requires no current from Q3 and most of the current from the current source Q4 is used to drive the lower portion of the output section. Thus on positive half-cycles, Q3 supplies output *plus* current source and on negative half cycles current source *less* output drive. Obviously the driving signal at the base is going to be very unsymmetrical under these conditions.

So what can be done to improve on this situation? Obviously a push-pull driver would be a good solution. Then we would have two signal swings on opposite ends of the circuit that would still be unsymmetrical, but which would be of opposite polarity. Thus the distortion would be reduced as in any push-pull arrangement. There are several possible ways to drive such a system, but the most elegant is to use a complementary, cross-coupled input system. This makes the whole amplifier symmetrical and push-pull from the very input.

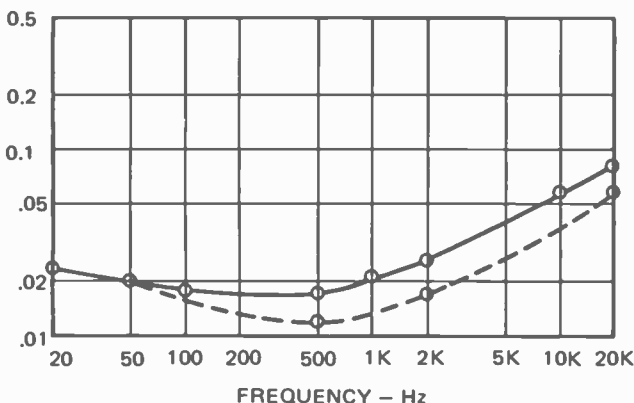
The complementary differential input stage also provides us with some additional advantages. With this type circuit the base current for the input pair does not all have to flow through the input resistor from ground and through the feedback resistor from the output as in a normal single ended differential pair. Referring to Fig. 5, the base current path is from Q1 into the base of Q5 provided that the base currents of the two transistors are equal. This results in *no* offset voltage across the input resistor.

Exact matching is impossible, but even if the matching is not perfect, we still have only the difference between the two base currents flowing through the input resistor to produce an offset rather than the entire base current of one transistor as in a single-ended situation. Since the differential current is so small through this resistor we can either make the resistor quite large and have a very high input impedance on the amplifier, or we can use a smaller resistor and get away with a rather large difference in base resistors without getting the considerable offset at the output of the amplifier that this would normally cause. Since input impedances over 50,000 ohms are of little value the latter course was followed on *Tiger .01*.

The only thing remaining is to choose a bias system for the output stage. The input amplifier pretty well dictates the use of a transistor for this purpose. The dual dif-

#### TOTAL HARMONIC DISTORTION

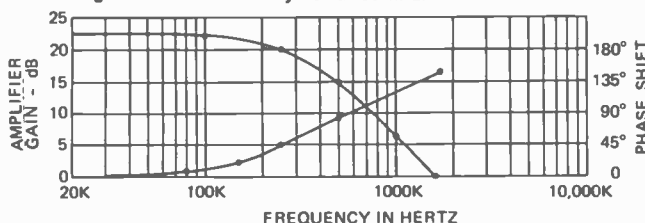
REFERENCE POWER 60 WATTS ———  
HALF POWER -3 dB - - - -



TOTAL HARMONIC DISTORTION is very low at all frequencies (curves above) and is less than 0.1% at full- and half-power levels.

DISTORTION VARIATIONS WITH POWER are illustrated by curves at left. Typically, IM distortion is below THD up to rated power output.

GAIN-PHASE PLOT (below) shows how little phase shift there is in the audio range. Phase shift is only 10° at 80 kHz.



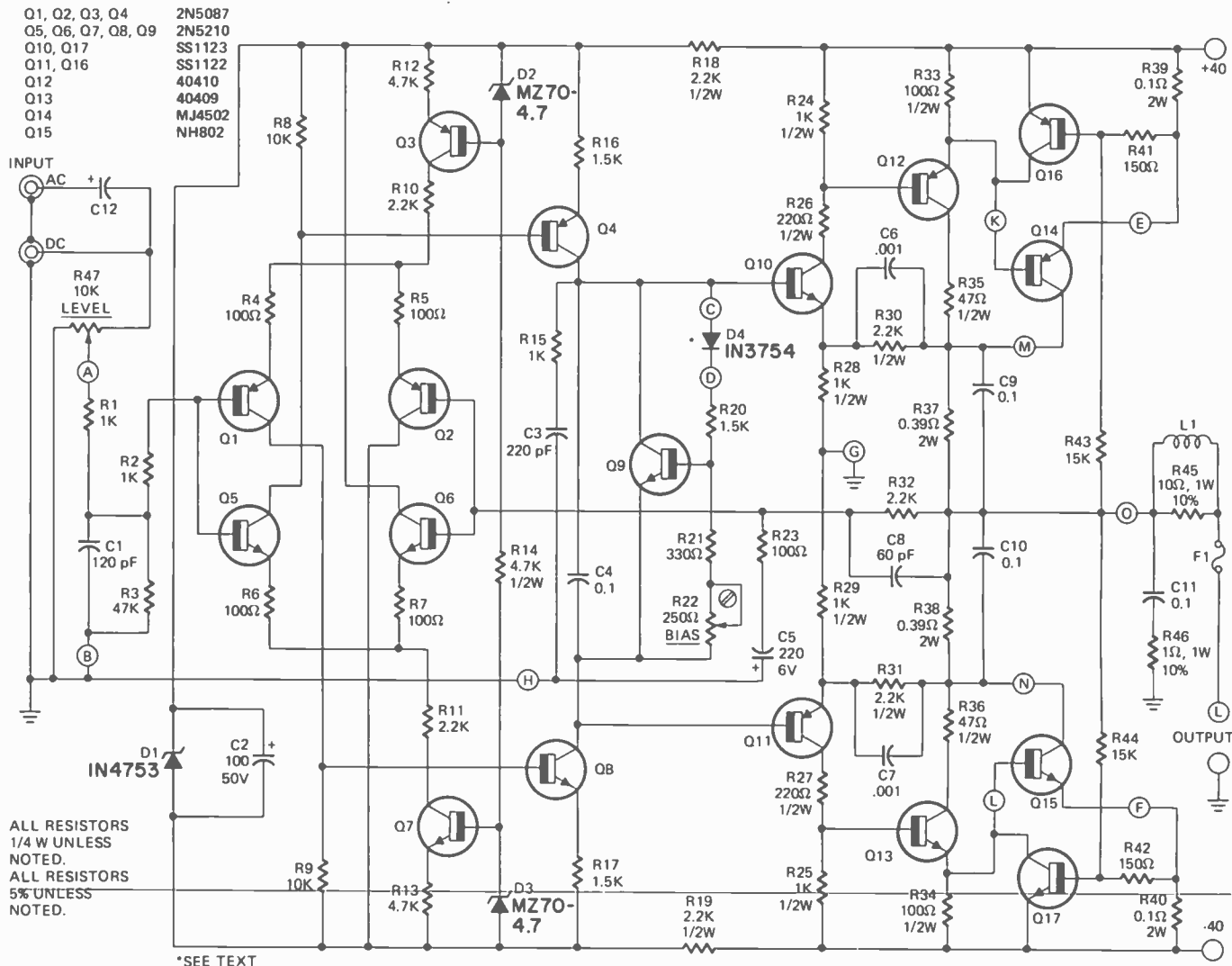


FIG. 6—COMPLETE CIRCUIT OF ONE OF THE FOUR CHANNELS. PC board patterns and complete construction details next month.

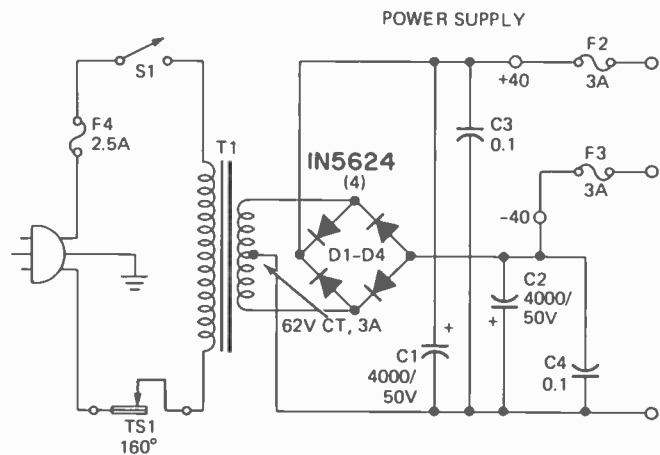


FIG. 7—POWER SUPPLY FOR ONE CHANNEL. The bridge rectifier supplies the dual-polarity voltages needed for the amplifier.

ferential input stage cannot be perfectly temperature compensated easily. As a result the idle current in the driver stage varies with temperature to some extent. If we attempted to use diodes for bias, this current variation would result in bias voltage changes. This is highly undesirable, and besides this it would take a bunch of diodes to get the 3 to 4 volts of bias that we need with this circuit (Fig. 6).

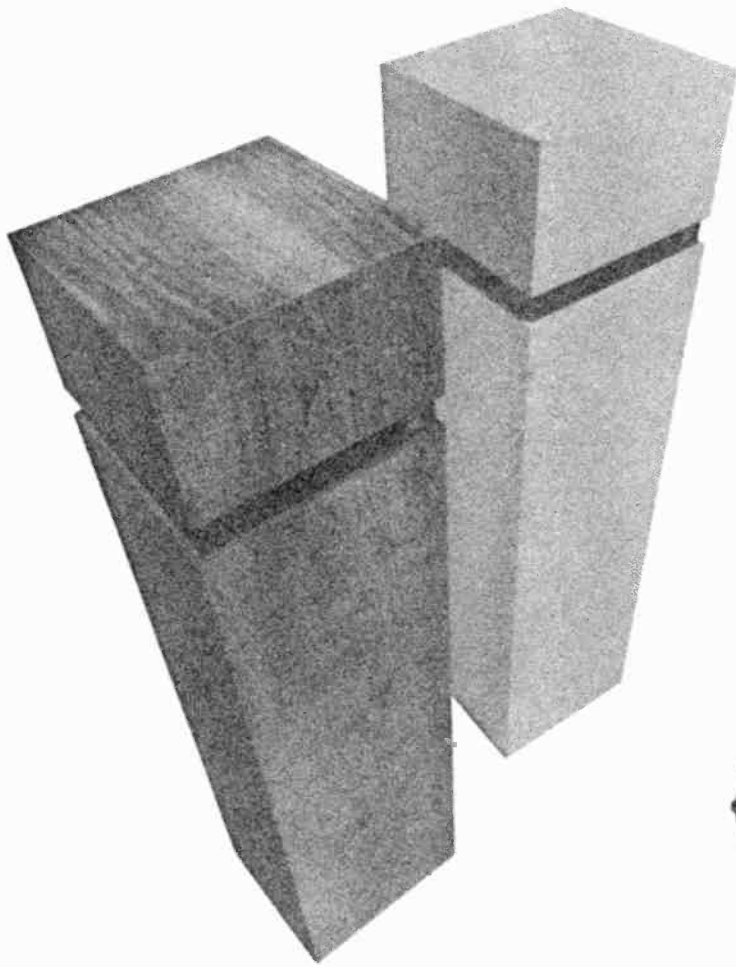
The bias voltage is set by the emitter-to-collector voltage drop across Q9. This voltage tracks quite well with the base-emitter voltage changes of Q10 and Q11 when ambient temperature changes occur. The temperature of the output transistors however is more dependent on the power output at any given time and Q9 needs some feedback information on this temperature rise if anything is to be done about stabilizing the output current with these tem-

perature changes. This information is provided by D4. The diode's forward voltage drop changes with temperature and changes the bias on Q9 to reduce the bias voltage slightly as the output transistors warm up. All this keeps the amplifier's idle current under control under all power output and ambient temperature conditions it is likely to be subjected to.

The power supply is a simple bridge rectifier system with capacitor-input filters. Due to the large amount of isolation from supply ripple and hum in the voltage amplifier stages, excellent noise figures are obtained without any complicated regulated supplies. It is doubtful that any measurable improvement would be obtained if such a supply was used. The output transistors are protected from highly reactive loads by Q16 and Q17. These transistors monitor the output transistor current and voltage drop. If either of these, or a combination of the two occur that could cause operation of the output transistor outside its rated safe operating area the protection transistors will turn on and bypass enough drive current to keep the output device from going into secondary breakdown.

That's all we have room for this month. Next issue we'll present full construction information; along with parts lists, full-size circuit-board patterns, and parts layout diagrams. We'll also have additional photos of the unit. R-E





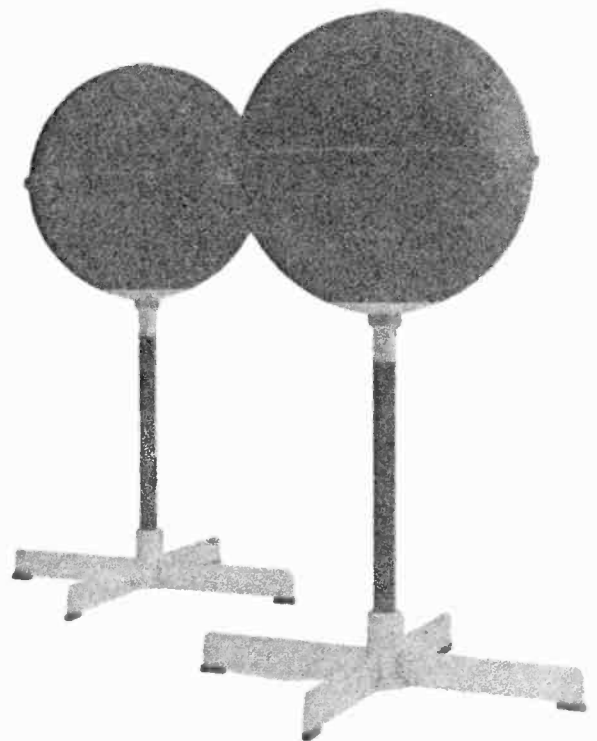
# off-beat 4-channel speaker systems

ALTHOUGH THE WOMEN'S LIBERATION MOVEMENT IS CONSIDERED a recent phenomenon, any fellow interested in good sound knows that it's been around for something like 15 years—since the advent of stereo. The average married guy may be considered “Man of the House” in most respects, but just as often he is NOT when it comes to the “furniture side” of running a household. This is the province of the “Lady of the House,” and woe be to anyone trying to tamper with it . . . like adding “those boxes” that are an integral part of stereo.

Fortunately, several years ago the acoustic-suspension speaker system was developed, and manufacturers used them as aid to beleaguered husbands wanting to move from mono to stereo sound. The compact speaker systems they had conceived could readily and unobtrusively be incorporated into Ye Lady of the House's province. In one swoop the manufacturers saved thousands of threatened marriages, and virtually assured the future of two-channel stereo sound.

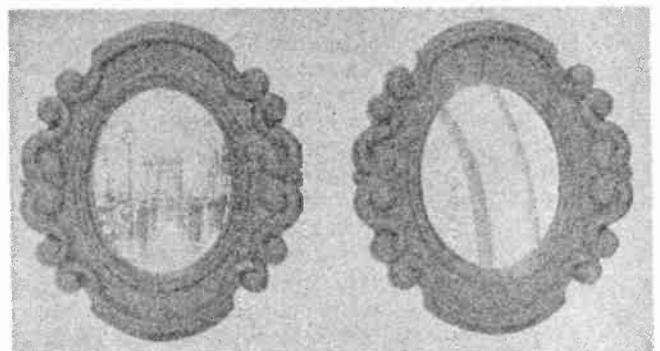
And all was well for several years. Until four-channel sound evolved. Many a stereo buff has been sitting on the sidelines for the past four years, reluctant to go through the hassle of convincing his wife that sound has advanced another stage, and that to attain the benefits of “The New Order” some concessions to home decor are required. And so he sits, only sporadically listening to his OLD two-channel rig and chomping at his innards with frustration because his wife won't let him add *two more* boxes—attractive as the current ones may be—to louse up her decorating scheme.

Enter a few speaker manufacturers who have obviously been on top of the situation, and are foxy enough to know that if you can't fight 'em, join 'em. They have come up with several intriguing approaches to “How To Get



*In 4-channel stereo, the question of speaker type and placement arises early. Here are some answers*

by FRED PETRAS



Around The Woman Of The House Relative To Quadraphonic Sound." Some of the approaches are actually variations on existing themes, while others are advances in concepts that the industry has been toying with for some time. Any one of these approaches might appeal to *your* particular Guardian of the Living Room and thus enable you to enjoy surround sound.

Before we go on to describe these new "lifesavers," a bit of background relative to their creation. One of the many unresolved aspects of 4-channel sound is, just what is the RIGHT approach to it? That is evident in the variety of basic systems—discrete tape, discrete disc, several matrix disc systems, and even proposals of a combination discrete/matrixed disc.

Within the framework of each of these is another unresolved aspect of 4-channel sound, namely, Should the conductor and engineers strive for a mirror image of the bandstand or concert hall, or should they get as far away as possible from mirroring reality and explore the potential of quad for some *new* sound ideas? Where companies have adopted the mirror approach, each has come up with his special way of handling it; where they have decided to generate a "new sound," they have also expressed themselves according to how they feel about the matter. The end result is that each new quad tape or disc, in whatever the basic system/approach, is actually a unique experience, further offering *several ways* to savor it.

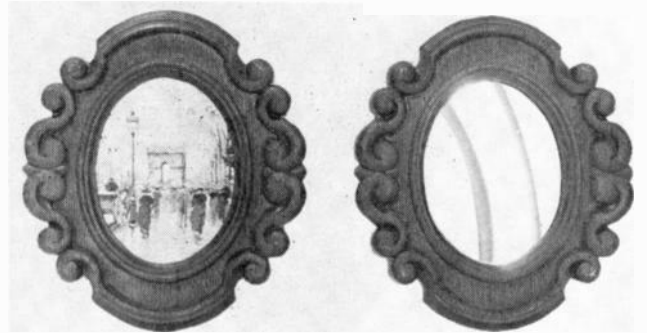
Which leads us to the final link in the chain—the speaker system. Talk to 10 different owners of quadraphonic stereo rigs and you'll probably get nine different expressions on how to play 4-channel discs and tapes. But within these expressions you'll find two *basic* schools of thought. One holds that all four speaker systems should be of a traditional design and the same general type, size, quality and efficiency, and should be placed according to rather precise guidelines. The second holds that your speakers need not all be near-comparable; that you need first-rate speakers for the front channels, but that the rear channel models can be entirely different in basic design, size, quality, efficiency, etc., because you can compensate for the differences with various controls. It also holds that since every quad disc or tape is unique unto itself in terms of recording, so too, can speaker placement be unique unto itself in terms of playback. This school includes manufacturers of the speakers we'll discuss. While these manufacturers as a group are anxious to aid 4-channel-hungry chaps in getting around Ye Keeper of the Decor, some point out that their decor-oriented products are not necessarily compromises in the way of quality sound. (We'll clue

you on those particular models as we go along.)

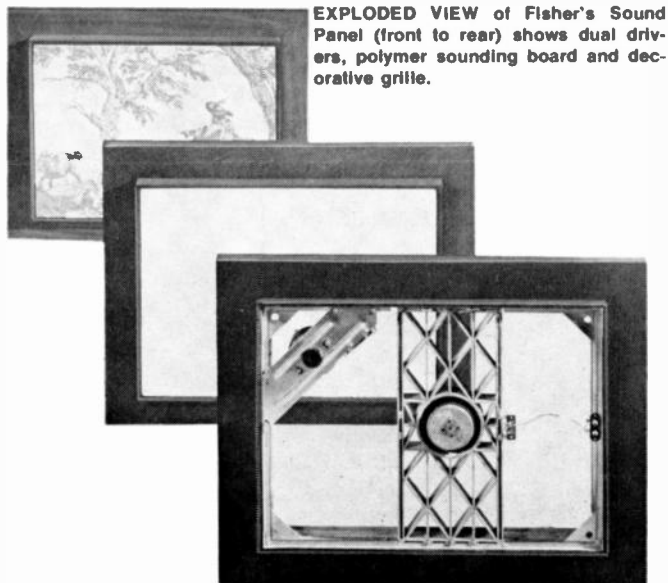
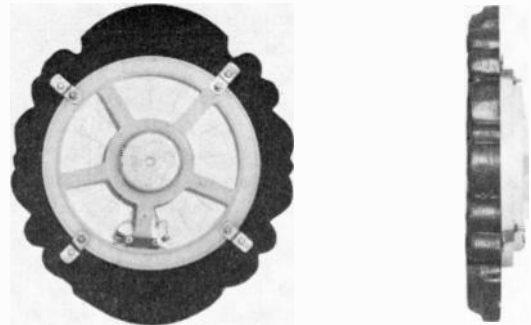
### Wall models in profusion

Slim-line speaker systems with traditional "guts" have been around for a number of years. They have not been a great success in the two-channel field since they are regarded as a hybrid. They have enjoyed more success in commercial applications where top-notch sound is less a factor than efficient use of space. But now there is a new crop of slim-line speaker systems on the scene, utilizing different "innards" than the old slim-lines. This new crop consists of two price ranges—low, and high, with sound fidelity being low/medium for the first group and truly high for the second.

The first group—"Poly-Planar"—utilizes thin panels of expanded polystyrene in a compacted bead structure instead of cone loudspeakers. This permits them to be incorporated in systems that are less than two inches thick. Developer of the concept, patent holder, and manufacturer of Poly-Planar systems is Magitran Co., Moonachie, N.J. Magitran offers such speaker systems in the form of framed



MAGITRAN MODELS DS8P and DS8M (above) picture and mirror speakers, respectively. REAR AND SIDE VIEWS (below) show construction based on the maker's Poly-Planar concept where panel replaces the speaker cone.



EXPLODED VIEW of Fisher's Sound Panel (front to rear) shows dual drivers, polymer sounding board and decorative grille.

mirrors and framed pictures in rectangular and oval shapes for living room wall use, at \$17.95 and \$24.95. While the bass response of the units—when used by themselves—could not be called hi-fi in the generally accepted sense of the word, and claimed specifications notwithstanding, their sound is first rate when they are used *in conjunction* with true hi-fi front-channel speaker systems. What happens is that the bass response of the rear-channel Poly-Planar units is reinforced by that of the front-channel units and the end result is an illusion of solid bass emanating from the wall area where the thin speakers operate. (This same phenomenon is apparent with some of the other systems.)

Fisher Radio recently came out with its version of "picture" speaker systems. They use high-density acoustical polymer diaphragms and twin drivers—for low-frequency and high-frequency sounds. Their dispersion is fully omnidirectional—360 degrees. Called "Sound Panels," the new models are true hi-fi speaker systems. Four of them can be

used for the total speaker complement of a 4-channel system in place of traditionally designed systems, or two can be used for front-channel operation combined with traditional speakers for rear-channel use, or vice versa. Their bass sound needs no reinforcement. The units—a shade thinner than three inches—can also be used in special floor mountings to function as decorative screens, as for example flanking a fireplace. The Lady of the House may also incorporate them into room dividers, or work them into a hanging wall—such as a beaded screen type.

The Magitran picture speakers permit removing the existing picture and substituting another. The visual designs of the Sound Panels cannot be changed since they are “welded” to the polymer diaphragms.

### Conversion units

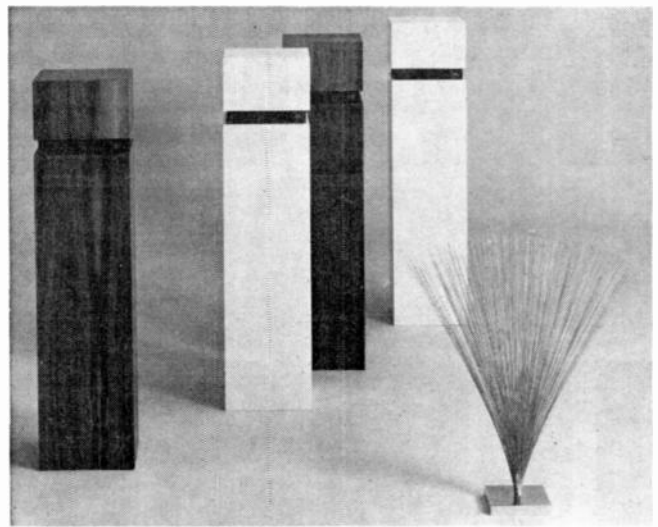
Since the advent of two-channel stereo, there have been sporadic attempts to put across speaker converters—units that change a flat surface into a speaker system. The most widely acclaimed appears to be the Poly-Planar concept as offered in Magitran’s mirror and picture speakers described earlier. In addition to finished decorative speakers, Poly-Planar speakers come as panels in a variety of configurations, permitting you to get around The Lady of the House by “turning on” tables, doors, walls, wall panels, and other objects of decor and furniture to function as speaker systems for rear-channel use. They are priced from \$8 to \$19.

Another conversion approach is in the form of a round 3½-inch diameter by 1½-inch thick driver unit from Hi-Vi Systems, San Clemente, Calif. Priced at \$19.95 each, the units convert many resonant objects into speaker systems. We heard them installed on 4 by 8-foot sheets of ¾th-inch thick decorative plywood and found their sound to be comparable to many of the simpler, more basic compact speaker systems, with an openness and solid bass that some of the latter did not possess.

Unlike earlier lighter weight devices of this type, the Hi-Vi models have excellent transient response. Note: The Hi-Vi units are strongly dependent on the objects to which they are attached; hence, their performance will equate to how well those objects disperse sound vibrations. The company mentions that they work well on the following surfaces: Fiberglass, plastic, glass, dry wall, metal, plaster board, and Celotex. An executive of the firm also writes as follows: “We have found that when these units are installed aboard a boat that has a clean hull, and when they are played continually with either music or through a low-cycle oscillator that no barnacles or other marine infestation will occur. The same holds true in homes where termites or other wood boring pests are a problem. We are doing further development, and will shortly have data with facts and figures to substantiate our claim.”

### Columnar systems

At least three companies have come up with double-duty columnar speaker systems that may be just the thing to solve your wife’s hangup about adding two more speaker systems to “her” living room. All three products are attractive in their own individual ways, and each takes up a minimum of floor space—14 inches square at most. All three can serve as pedestals on which to place appropriate objects of art, vases of flowers, etc., to enhance Ye Little Lady’s living room. Additionally, these models can be used effectively in corners of a room. Each provides first class sound of a quality that would permit four to be used as a total quad speaker system complement, or in conjunction with existing speaker systems either up front or for rear channel sound. The most widely distributed of the units is the JBL “Aquarius 4” priced at \$186. It comes in oiled walnut or satin white finish. It is 40 inches tall and is 10 by 10 inches at its base. In somewhat limited distribu-



**AQUARIUS 4 COLUMNAR SPEAKERS** by JBL are 40 inches high and 10 inches square at the base. They come in oiled walnut and satin white finishes.

tion is EPI Model 400. “The Minitower,” a 38-inch-high column whose base is 14 by 14 inches. Its appearance is both subtle and striking; black grille cloth is framed by four corner posts of solid walnut accented by a brass extrusion. The top is solid walnut. The price, \$389 each. Both the above models have a dispersion of 360 degrees. The third unit, Equasound Two, priced at \$219.95 in walnut or white, and \$239.95 in rosewood, has a dispersion of 270 degrees. It measures 42½ inches high, and is 11½ by 11½ at its base. The systems come with three removeable side panels and matching leather top piece, in a choice of black, orange or blue grille fabrics.

### Molded-plastic units

In a class by itself is JBL’s “Prima 25” series, whose bright-hued housings are of a heavy molded plastic. Not only are the Primas two-way as speaker systems, they are two-way in that the housings are also available in the form of matching storage modules. Further, the housings are molded in a way that permits them to interlock when used in multiples (see illustration) as combinations of speakers and housings. The Prima 25 series is available in a dozen different colors, including green, yellow, red, grey, white and black, with various related grille fabric colors. The in-

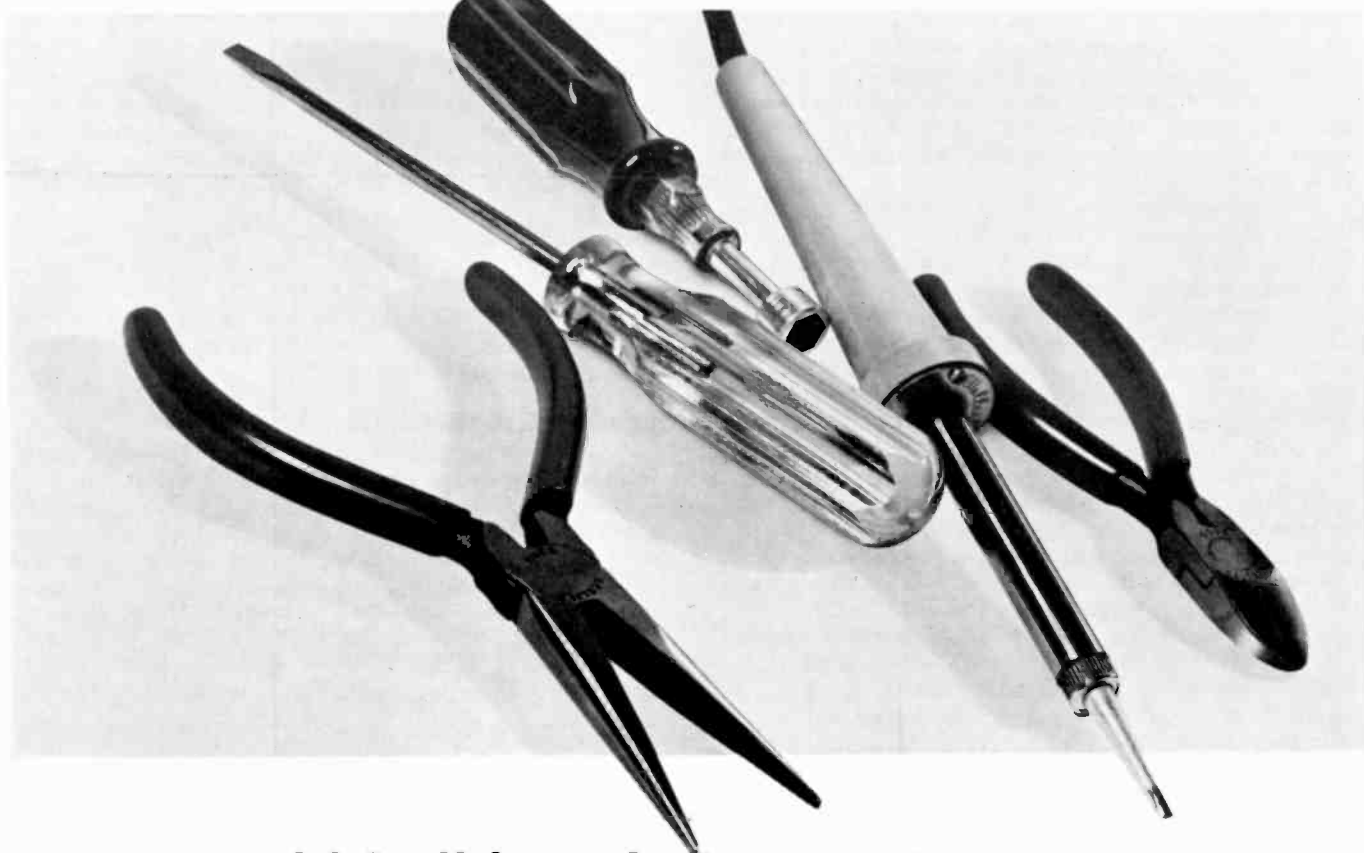


**JBL'S PRIMA 25 SERIES** speakers come in decorator colors. The housings are also available as storage modules for components.

terior colors of the storage modules relate to the speaker grille colors. The Prima 25's can be stacked horizontally or vertically. As speakers they cost \$126 each. As storage units they cost \$48 apiece. The Prima 25's are bound to appeal to any Queen of the Living Room whose preference is for bold, dramatic, yet tasteful modern styling. As speaker sys-

(continued on page 50)

# IF YOU CAN USE ANY OF THESE TOOLS...



...you could build a whole new future...

and build  
yourself  
a Bell & Howell  
solid state  
color TV while  
you're at it!





If you're already handy with a set of tools, here's a way to pick up a pretty thorough knowledge of electronics: build yourself a solid state color TV as part of a complete learn-at-home program. Your Bell & Howell Schools representative is ready to bring you all the free facts you need. Mail the card now.

This important project gives you valuable "hands on" experience with solid state circuitry—the kind of *practical* experience you'll need to build a successful career. It's a vital part of your total electronics education.

Once you've completed your program, you could be ready to build a new career—or start a business of your own—in home entertainment electronics.

#### Fix stereo systems . . . FM-AM radios . . . phonographs . . . tape recorders

With your new skills, you can build and service stereo-hi-fi systems—including FM-AM radios . . . phonographs . . . open reel tape recorders and cassette or cartridge player/recorders. You could even build yourself a complete "home entertainment communications center"—complete with the new gadgetry of cartridge television when it comes out. The skills you build up by following this brand-new program are more than enough to service almost any type of home entertainment electronic device.

#### A complete at-home learning program in home entertainment electronics

Don't confuse this program with an ordinary hobby kit. It's much more than that. It's a complete at-home learning program prepared by skilled instructors at Bell & Howell Schools.

It doesn't matter if you've never had any training in electronics before. Nobody's going to start throwing "diodes" and "capacitors" at you right off. You start with the basics. You take it one step at a time. You walk before you run. And you'll be amazed at how quickly you start to feel comfortable with things that seemed complicated at the beginning.

#### Attend special "help sessions" if you like

In case you should run into a sticky problem or two—one that you can't handle on your own—come in and see us. We've scheduled help sessions every few Saturdays at the Bell & Howell Schools and in many other cities throughout the U.S. and Canada. Drop by. Meet an expert instructor in person. Talk over any rough spots with him—and with other students. You'll enjoy the chance to "talk shop."

#### Master the most up-to-date solid state circuitry

Solid state is here to stay. Not just color TV but almost every type of electronic device will eventually move farther and farther in the direction of *total* solid state circuitry. Get to know the most advanced "trouble-shooting" techniques for these sophisticated circuits. You'll find an almost irresistible demand for your skills.

#### Why you should know electronics

No matter where you look, the amazing

technology of electronics is becoming a bigger and bigger part of the picture. More and more automotive parts and diagnostic instruments are electronic. Many large manufacturing plants use sophisticated electronic systems—controlled by a few skilled electronics technicians. The increasing use of two-way radio . . . the huge promise of cable television . . . the astonishing growth of electronic data processing all open doors to exciting new career opportunities for the man with thorough training in electronics. In fact, the day may come when the man who does *not* have electronic skills will be severely handicapped in many industries.

#### Why you should get your training from Bell & Howell Schools

Skilled instructors at Bell & Howell Schools—carefully selected for their knowledge, experience and teaching ability—plan each program with the utmost care and attention. Each year, they spend about \$200,000.00 improving programs and materials and keeping them in step with new developments in electronics. Thousands of people have used their Bell & Howell Schools training as the foundation for new careers and businesses of their own in electronics.

#### You build and keep the exclusive Bell & Howell Schools Electro-Lab®—a complete laboratory-in-the-home

To make sure you get practical experience with instruments used daily by professionals, you build and keep a Design Console, an Oscilloscope and a Transistorized Meter (see details at right). These are the three instruments you'll work with constantly—both during your program and thereafter.

#### CONSIDER THESE ADVANTAGES:

**Help Sessions** We've scheduled "help sessions" every few Saturdays at the Bell & Howell Schools and in many other cities throughout the U.S. and Canada. Top instructors give you expert guidance and you meet other students, too.

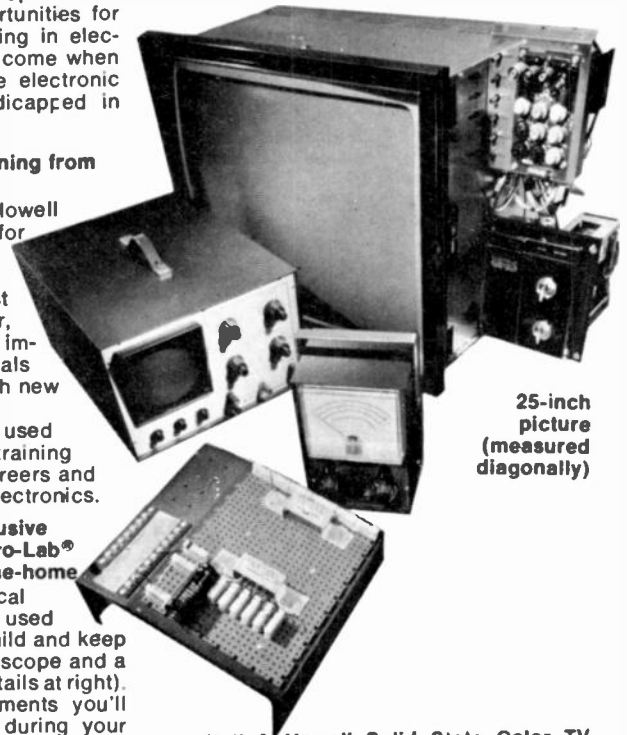
**Resident Study** After you complete your program, you can transfer to any of the resident schools for more advanced study, if you wish.

**Lifetime National Placement Assistance** When you complete your course, we help you locate a position in the field of Electronics that fits your background and interests. This unique service is available at any time after you graduate.

**Veterans' Benefits** We are approved by the state approval agency for Veterans' Benefits. Check the box for details.

**Student Financial Aid** We are an eligible institution under the Federally Insured Student Loan Program. Check the box for details.

Detach postage-free reply card, fill out and mail today



25-inch picture (measured diagonally)

■ **Bell & Howell Solid State Color TV.** Ultra-rectangular tube . . . 25-inch picture measured diagonally . . . full 315 sq. inch viewing area. Solid state modular circuitry . . . 4 advanced IC's . . . 100 transistors . . . 72 diodes . . . individual plug-in circuit boards. Special UHF/VHF tuning features . . . built-in self-service components.

■ **Design Console** Use this to rapidly "breadboard" circuits without soldering. Equipped with built-in power supply . . . test light . . . speaker . . . patented plug-in modular connectors.

■ **Oscilloscope** Portable 5-inch wide-band oscilloscope offers bright, sharp screen images . . . calibrated for peak-to-peak voltage and time measurements . . . 3-way jacks for leads, plugs, wires.

■ **Transistorized Meter** Combines most desired features of vacuum-tube voltmeter and quality multimeter. Registers current, voltage and resistance measurements on a large, easily-read dial. Features sensitive, 4-inch, jewel-bearing d'Arsonval meter movement.

#### Mail Postage-Free Reply Card Today!

If card has been removed, write:

An Electronics Home Study School

DEVRY INSTITUTE OF TECHNOLOGY

ONE OF THE



**BELL & HOWELL SCHOOLS**

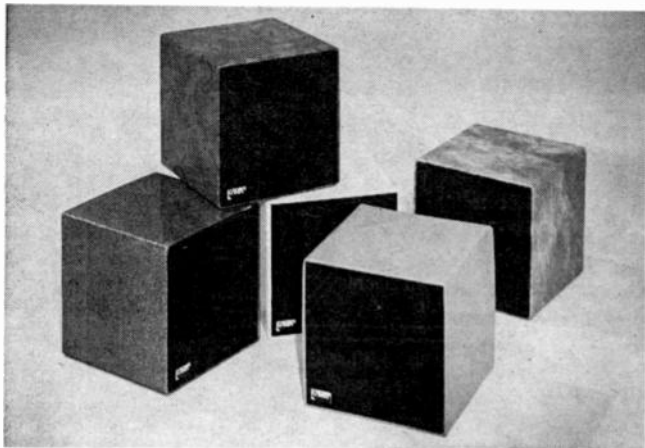
4141 Belmont, Chicago, Illinois 60641

354

tems, they'll hold their own against most models in their price class. Four Prima 25's can serve as a full 4-channel speaker complement, or they can be used in conjunction with other speaker systems, either up front or at the rear.

### The fiberboard approach

Back in the early days when hi-fi was evolving from mono to two-channel stereo, a lot of budget-strapped do-it-yourselfers embraced the cardboard box concept of speaker systems. These were usually temporary makeshift affairs, enabling a fellow with a spare raw speaker to enclose it in virtually any handy cardboard box and use it until he could afford to buy a finished unit to match his existing system, or go out and buy a new matched pair of systems for stereo.



**THE KRIKET MODEL 850 SPEAKER SYSTEMS** by Acoustic Fiber Systems are in tooled leather and vinyls in decorator colors.

Well, this concept has returned—but in a highly sophisticated form, and one that should have broad appeal to Ye Hausfrau with a yen for bright colors and unusual textures and designs. It should also appeal to the four-channel-hungry guy who wants to meet his wife nine-tenths of the way, but also wants reasonable sound quality. The concept returns in the form of the "Kriket" and "Nirvana" lines of speaker systems from Acoustic Fiber Sound Systems, Indianapolis, Indiana. AFS touts the merits of fiberboard by describing it as "The Working Wall." A company brochure states that "The Working Wall is composed of two walls of tubes set at right angles to each other and bonded tightly together. The sound waves are absorbed into the tubes and are transformed into directional wave patterns opposing each other. This principle of polarization allows the sound waves to cancel themselves and leaves the speaker to perform unrestricted."

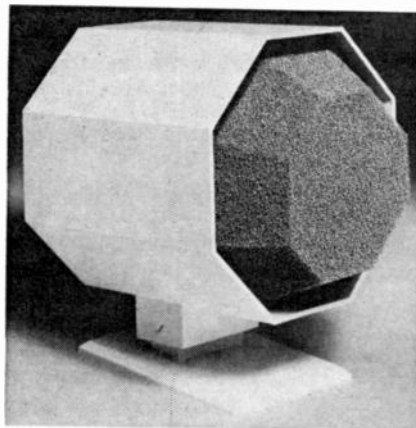
In checking out two different pairs of AFS systems (Nirvana 400 and Kriket 850) we were convinced that the principle is valid; the sound emanating from the units was open and uncolored and was of an overall high quality, albeit a bit shy at the bass end in the "flat" response position. But a slight turn of the bass control corrected the shortage.

But let's get on to their appeal to The Lady . . . AFS systems come in cube or rectangular form in at least eight solid colors, and a variety of smooth-surface patterns, including straight stripes, undulating tiger stripes, polka dots, and marbelized. There are also a number of textured finishes including tooled leather, suede, vinyl and cork. The systems also come in housings with Indian rag-rug fabric patterns, and—believe it or not—in fake fur coverings. AFS is also experimenting with other materials and designs, to give The Little Lady a chance to truly express herself quadraphonically. The AFS speaker systems range from \$29.95 per pair on up to \$198 per unit, depending on size,

components and coverings. The largest system contains a 12-inch woofer, 4½-inch midrange, and two-inch tweeter.

### Mini multi-mounts

Another off-beat speaker concept comes from Sound West, Inc., Van Nuys, California. Designed by Barney Rigney, well-known speaker pioneer, the units offer good sound in little space and at a relatively small price—\$14.95 each. Measuring approximately 6 inches by 7 inches by 7½ inches, the round, square or octagon units are mounted on a low pedestal base that permits angling them in a fairly wide vertical arc when used atop furniture, or firing down

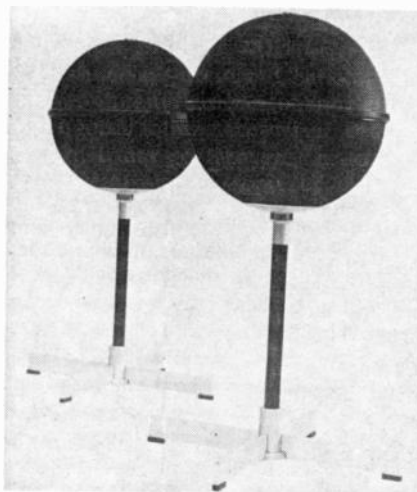


**MINIATURE LOUD-SPEAKERS** by Sound West are available in square, round and octagonal enclosures. The foam grille lifts out for easy cleaning.

from a spot on the ceiling, or a horizontal or vertical arc when mounted on a wall. The round or octagon units in their white high-impact plastic housings are a cinch to incorporate in modern home decor. Ye Little Lady would probably consider the square models fine in a traditional furniture setting. All three types come with lift-out (for cleaning) foam grilles in rust, blue, gold, black or white. The Sound West minis can also function nicely outdoors . . . on a patio, or anywhere else you might want to hear music. In testing a pair of the devices in a four-channel setup we found their sonic attributes to be of a higher order than a four-inch speaker size would indicate. Their dispersion pattern is rather narrow.

### Spherical speaker systems

Another awareness of the Little Lady of the House is apparent in a spherical speaker system from JVC that can



**JVC'S MODEL VS-5313** spherical speaker system hangs or mounts on a pedestal. It has eight speakers inside its 13½-inch perforated housing.

operate as a pedestal or as a hanging model. Model VS5313, priced at \$179.95 each, contains eight speakers within its 13½-inch diameter black perforated housing. Offering a claimed 20 to 20,000 Hz response, in a 360-degree

(continued on page 90)

# TAPE BIAS LEVEL

## key to quality recording

*Only a small change in bias level can make a rather startling change in the frequency response characteristics of the recorded material*

by HERB FRIEDMAN

ALL ELSE BEING EQUAL, CASSETTE recording quality is primarily determined by the bias level applied to the tape. In fact, except for the two-for-a-buck cassettes, even when things aren't equal it's still the bias level that primarily determines if the final sound playback will be acceptable to the average audiophile.

As *Radio-Electronics* showed in the March, 1972 issue, virtually no two cassette tapes have the same high-frequency performance when recorded on the same recorder with the same bias level. If the same series of tests are run on another recorder factory-set to a higher or lower bias level, the scope traces shown in the March issue would be vastly different.

Yet, with rare exception, most cassette recorders can have their bias adjusted for a "flat" response with any quality cassette tape. On some of the latest model recorders there is a choice of up to three bias levels, making it much easier to match tape to machine through factory-set bias levels.

Before you challenge the contention that a tape's frequency response can or should be corrected by an adjustment in bias level, keep in mind that we are not dealing with reel recorders where the playback equalization is set for "flat" response from an NAB test tape, where the bias is then adjusted for maximum midband output (or 0.5 dB down on the high side), and, finally, adjustable record high-frequency equalization is used to obtain an overall-record/play "flat" response.

Cassette recorders do not, as a general rule, have an adjustable high-frequency record equalization. Hence, we cannot adjust the bias for maximum midband output, lowest distortion or lowest noise and then hope to correct the high-frequency response losses (or gains) with record equalization. As with many things about cassettes, we must compromise, and a

major compromise is that frequency response corrections must be made through a change in bias.

Before bias adjustments we should get two points out of the way, as they can lead to confusion: (1) Over a reasonable range of bias level, say +20/-10 percent of the factory-set bias level usually used for "standard tape," there will be very little change in distortion at the "0," or maximum recording, level. In most instances there will be no measurable change. (2) Similarly, there will be no, or little change, in the signal-to-noise ratio—perhaps up to 2 dB. The change in signal-to-noise ratio caused by a change in bias level will be determined by the bias change's effect on the tape's midband (400 to 1,000 Hz) output.

To illustrate the relationship between bias level and frequency response, four popular tapes were selected for use with a Kenwood KX-7010A recorder; the Kenwood was chosen because it has a "regular" and a "low-noise" bias selector, and because the bias level can be easily adjusted on this machine. (In all tests the frequency response was swept from 50 to 20,000 Hz.)

The first thing that comes to mind is what constitutes "regular" or "low-noise" tape other than the manufacturer's specification—which can often be meaningless because "low noise" is frequently a term used solely for advertising purposes. What can the user expect in the way of performance if he makes a wild guess on the proper bias selection? In some instances he'll

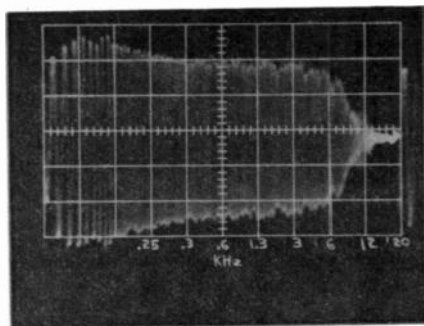


FIG. 1-a—STANDARD BIAS used to record swept audio spectrum on Scotch High-Energy.

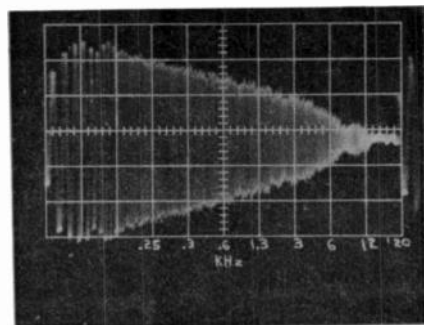


FIG. 1-b—LOW-NOISE BIAS used to record swept audio spectrum on Scotch High-Energy.

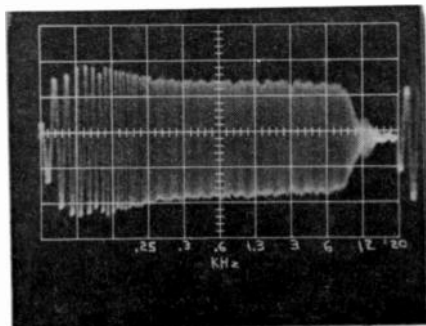


FIG. 2-a—STANDARD BIAS used to record swept audio spectrum on Norelco 100 tape.

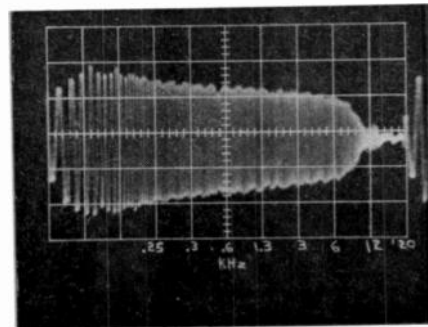


FIG. 2-b—LOW-NOISE BIAS used to record swept audio spectrum on Norelco 100 tape.

win, in others he'll lose.

Figs. 1, 2 and 3 show the performance obtained from three popular tapes using the two bias levels provided on the Kenwood recorder. Fig. 1 is Scotch High Energy tape, supposedly a low-noise tape, yet the performance obtained with "regular" bias is much better than that obtained with "low-noise" bias. Although the low-frequency performance remains the same—as it will with most other tapes—the "low-noise" bias degrades the midband 6 dB, while the high end, at 10 kHz, is degraded almost 15 dB.

Fig. 2 illustrates the same bias levels on Norelco 100 tape. Here the midband is degraded less than 1 dB while 10 kHz is attenuated about 4 dB.

Fig. 3 is Maxell UD tape. As a

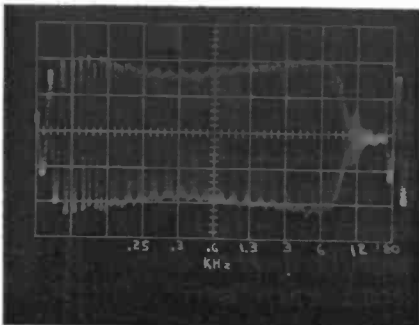


FIG. 3-a—STANDARD BIAS used to record swept audio spectrum on Maxell UD tape.

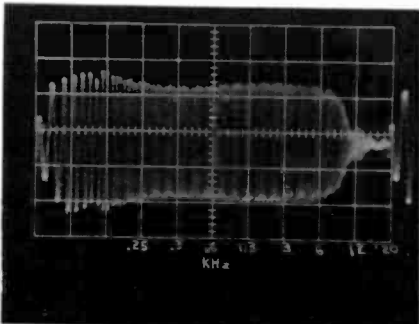


FIG. 3-b—LOW-NOISE BIAS used to record swept audio spectrum on Maxell UD tape.

starter, note that the high end tends to rise with the "regular" bias; at 6 kHz the response rises +1.3 dB. With this tape the "low-noise" bias attenuates the entire frequency range output as well as degrading the high end to almost a flat response.

In typical use any of these three tapes on a Kenwood recorder would give an acceptable performance using "regular" bias. The Scotch tape would tend towards a mellow sound, the Norelco tape would be most "normal" and the Maxell would be slightly bright. But only the most critical listener would single out the Norelco tape as being "flat." On the other hand, "low-noise" bias would deliver a "flat" response from the Maxell tape.

Because there is a considerable variation to be found in a tape's frequency response in the relatively large limits between "regular" and "low-noise" bias (about 25%), it's obvious that a small bias correction can be used to shift the overall record/play performance to a "flat" response. In fact, a careful bias adjustment can be used to tailor the high-end response to a specifically desired performance level—either slightly peaked or attenuated.

Figs. 4 and 5 illustrate the frequency response variations that can be obtained with just a small change in bias level. The two tapes used are Maxell Low-Noise and Maxell UD, selected because with "regular" bias their frequency response characteristics are almost identical. Note that the Low Noise tape is quite good. In fact, when the Kenwood's bias selector is set to "low noise" bias the Low Noise tape's performance is down 6 dB at 10 kHz, as shown in Fig. 6 This is a common problem the cassette user

faces: because a tape is labeled Low Noise does not necessarily mean "low-noise" bias values should be used. The designation Low Noise can—and often does—mean only that the tape itself has inherently less noise than the manufacturer's previous product, and the bias level might have absolutely nothing to do with it.

Note in Figs. 4 and 5 that when the bias level is reduced 10% below the "regular" or "standard" bias level the effects on the two tapes are considerably different—even though they are almost identical with "regular" bias. First, the midband output of the Low-Noise tape remains essentially the same. The UD tape, however, shows an increase of 1 dB.

Second, and more important, while the Low-Noise tape shows an increase of only 1 dB at 7 kHz, the UD tape shows an increase of almost 2 dB at 7 kHz when the biased is reduced 10%. At 10 kHz the Low-Noise tape shows virtually no change; the UD tape shows an increase in output

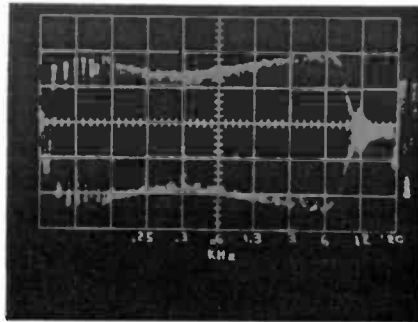


FIG. 4-a—BIAS LEVEL IS REDUCED 10% to record this pattern on Maxell low-noise tape.

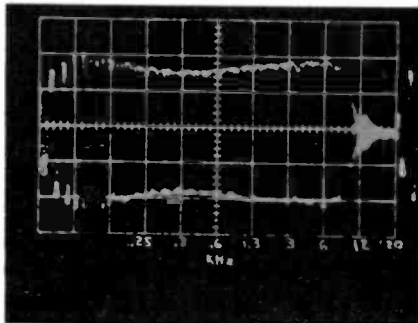


FIG. 4-b—STANDARD BIAS produced this recorded pattern.

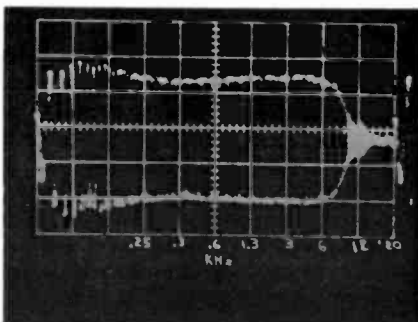


FIG. 4-c—BIAS LEVEL IS INCREASED 10% to record this pattern.

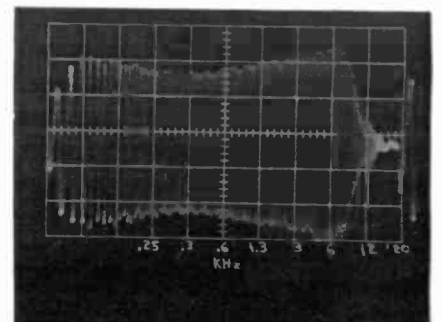


FIG. 5-a—BIAS LEVEL IS REDUCED 10% to record this pattern on Maxell UD tape.

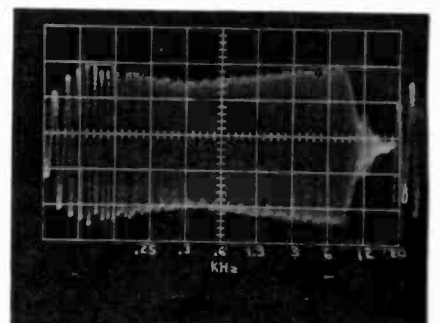


FIG. 5-b—STANDARD BIAS produced this recorded pattern.

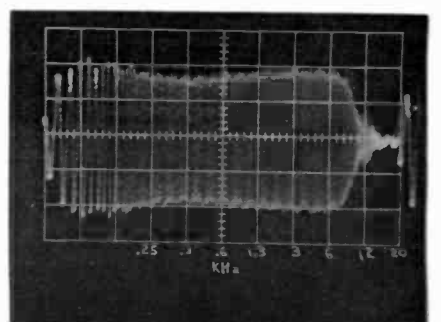


FIG. 5-c—BIAS LEVEL IS INCREASED 10% to record this pattern.



of almost 2 dB. How far the high end can be peaked is illustrated in Fig. 7, which shows the UD tape with 20% less than "regular" bias. There is little, if any, effect on the low-frequency performance.

Just as decreasing the bias will peak the high-end response, increasing the bias will attenuate the higher frequencies. But observe in Figs. 4 and 5 that while it takes a 20% increase in bias to "flatten" the Low Noise tape's response, the same degree of "flattening" with the UD tape requires only a 10% increase in bias.

Ability to control the high-frequency performance of recording tape by modifying the so-called *regular* or *standard* bias level means that just about any quality tape can be precisely matched to cassette recorder as long as the bias change isn't carried to extremes. If a tape requires more than a +20% change it's best to try a different tape. It's true that many "white box" tapes with very poor high-frequency performance can be made reasonably flat by decreasing the bias as much as 50% (to peak the high end). But this much change generally pro-

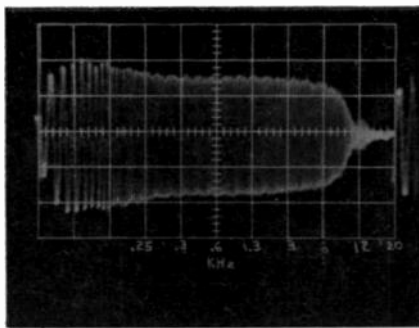


FIG. 6—LOW-NOISE TAPE with low-noise bias gives poor high-end response.

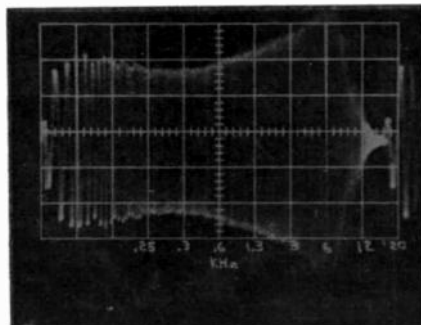


FIG. 7—HIGH-END CAN BE PEAKED by reducing bias level. Bias is decreased by 20%.

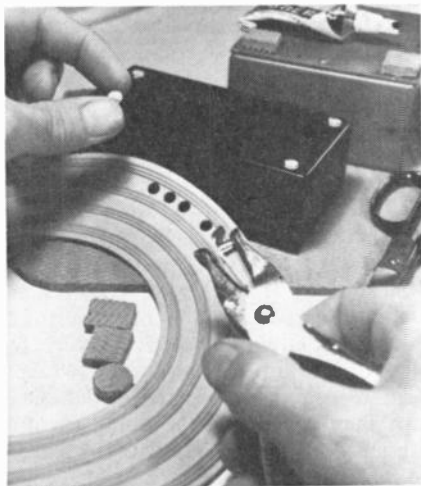
duces sharply increased distortion, poor signal-to-noise ratio, etc.

An important point to bear in mind when tailoring a cassette recorder's overall response by modifying its bias level is don't let the tape manufacturer's designation confuse the situation. Tape Brand A, designated as Low Noise, might truly require a "low noise" bias level. However, Brand B's Low Noise tape might be nothing more than "regular" or "standard" tape, or even "white box" tape. Trying to use both brands on the same recorder because they are both called Low Noise can produce two completely different levels of overall performance—one good, one downright rotten.

The match between tape and bias level is so critical in the cassette system that a 20% bias level error—which is not uncommon—can cause the best tape, used on the best recorder, to produce a final performance no better than that delivered by the cheapest quality recorder. The Rule: If you can't match the tape to the recorder, get in there with a screwdriver and do the job yourself. **R-E**

#### RUBBER FEET FOR TEST INSTRUMENTS

Miniature test instruments can be pretty unsteady when—out-weighted by their test leads—skid all over the workbench. A firm footing can be gained by cutting non-skid feet from a rubber pad such as from an old phono



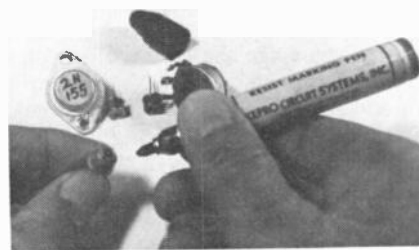
turntable. A hole-punch cuts feet for small equipment. Discarded typewriter pads make excellent shock-absorbing pads for small and large equipment. A pair of scissors can be used to cut pads of any size and shape.—*Frank Gilpin*

#### MARKING JUNKBOX PARTS

Junkbox parts have a tendency to lose their identity with handling and time. Felt-tip marking pens and grease pencils leave marks that just don't stand up or last for any length of time. A resist marking pen used for making etched printed circuits fills the bill beautifully. It has a fine

## benchnotes

point—great for marking small components, lasts indefinitely and, more important, it marks on any surface in-



cluding shiny metal and the glass envelopes of vacuum tubes.—*Frank I. Gilpin*

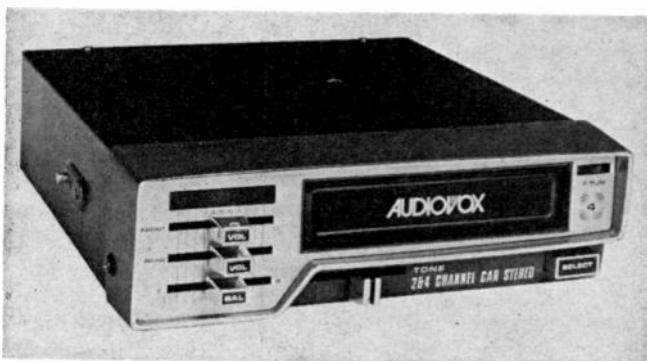
#### PARTS BINS EASE ASSEMBLY

Assembling a project of your own design or from a magazine article takes on the ease normally associated with a kit when you sort out components in a marked tray be-

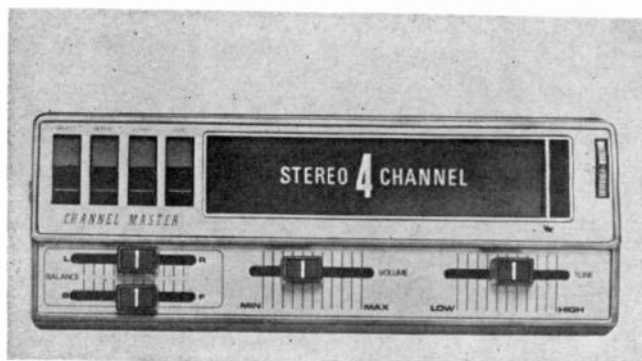


fore connecting and soldering. Egg cartons, candy trays and similar compartmented trays marked R1, R2, D2 etc., lend themselves well and make assembly a breeze.—*Frank Gilpin*

# STEREO ON THE GO—



AUDIOVOX MODEL C990 Q-8 tape player for discrete 4-channel.



MODEL 6294, BY CHANNEL MASTER is a 4-channel, 8-track player.

*Following car stereo in its boundless growth is 4-channel sound on wheels. Take a look at the latest in tape players*

by FRANK PETERS

IN THE PAST, COME SPRING, A YOUNG MAN'S FANCY TURNED to thoughts of love. Today, his springtime thoughts are just as likely to be about a car. Complete with cartridge tape player.

If your fancy lies in the direction of a car player this spring, you'll find that you never had it so good. The pickings are broad. The units look good. Many have more features for the dollar than ever before. The price range is wide. Quality at every price level is generally higher than in the past. Many models are vandal-proof. Many are double-duty types. And, if you're hot for four-channel sound, there's a load of quadraphonic players from which to make a choice.

Two or three years ago the car cartridge player market consisted mainly of two kinds of players—cheap basic units in the \$30 to \$50 bracket, and good quality models in the \$90 to \$120 range, with a smattering of decent sets at prices in between. Today there's a broad range, priced from \$40 on up to near the \$200 mark, with far more to choose from in the \$60 to \$80 bracket. In effect, there's a model for every budget, every taste and need.

Space limits prevent us from elaborating on all the changes that have taken place, so we'll hit just the high spots . . .

Back in 1970 and 1971, the industry lived through a deep slump, caused by a nationwide wave of auto player thefts that kept many a chap from replacing a stolen set, and kept many a fellow from buying his first add-on car player. As sales moved farther down on the charts, manufacturers began to panic. Some dropped their prices to attract lost business. Some came out with lower priced models of lesser quality, taking the approach that a player was a "disposable" on the order of a pocket transistor radio. But the more astute manufacturers took a different route; they stepped up their research and development efforts. In due time they came up with players that were virtually impossible to remove from a car . . . unless a thief had a blowtorch or the right tools, time and privacy for making a heist. As soon as these players hit the market, sales started to rise again.

This encouraged the industry to take a closer look at itself, to see what else could be done to make its products more interesting, and saleable . . .

- Like making double-duty models that operate in a car but can be removed for play in the living room.

- Like adding models with fast-forward controls to enable listeners to quickly pinpoint specific songs on a tape.

- Like coming up with models that contain a headphone jack, so a passenger can listen if the driver doesn't want to.

- Like producing models with smooth slide controls for quick visual settings.

- Like making better quality mini units for use in glove compartments . . . to lessen thievery or to accommodate cars with limited under-dash space.

- Like offering MORE models with: fine tuning to eliminate cross-talk; automatic program stop; easy, do-it-yourself installation potential; smooth, contoured lines for safety's sake; easier-to-operate characteristics; radio facilities, especially FM stereo; and, in line with being "with it," more four-channel models.

All in all, cartridge player equipment producers have done a good job to stimulate new interest in their products. If you've been hesitating about getting a new player—either a replacement or initial model—now's the time to stop doing so. As we said earlier, you never had it so good, in terms of what's viable, and available.

## On the 4-channel front

Since this issue of *Radio-Electronics* centers around 4-channel sound, let's see where 4-channel stands relative to automobile use . . .

Oracles in and out of the cartridge player industry say that Q-8 (quadraphonic eight) is going to surround a lot of people in four-channel sound, and is likely to establish four-channel sound as the big business it was predicted it would be. The Word is that 4-channel sound will become big in the car, then move into the home (as did the two-channel Stereo 8 cartridge), and that Q-8 cartridges may become even more popular than 4-channel records.

The predictions are based on three points. One, a car is an excellent acoustical environment for 4-channel sound, dramatically show-casing the qualities of Q-8's discrete surround-sound in a more effective way than the average living room. Two, Q-8 tapes are generally a more viable medium for discrete 4-channel primarily because they are less susceptible to wear than discrete 4-channel discs with their ever-so-complicated groove "squiggles" that require the utmost care and attention for continued full 4-channel effect. Three, Q-8 tapes have more *use potential*; unlike 4-channel records, they can be played in both auto or home environments. This fact alone, industry observers point out, is

# a round-up of tape players for your car



AUTOMATIC RADIO makes this model QME-2445. It features fine tuning.



PIONEER'S QP444 plays 2- and 4-channel cartridge tapes in your car.

likely to make Q-8 a mass-market sound medium, especially appealing to the younger generation looking for a lot for its money.

In addition to the foregoing, automobile Q-8 seemed like an ideal way for manufacturers to pump new interest into the cartridge format in the light of inroads being made by the cassette. While the cassette has been thrusting to make its way into the automobile, and has achieved some success there, it still has a long way to go. Cartridge proponents are using Q-8 as a way to block further inroads into the car field by the cassette. End result . . . a lot of new four-channel equipment for car use.

As we go to press, at least 24 companies have one or more surround-sound car players in their lines. And more companies will be entering the business as the concept catches on. Companies now in the field will expand the number of their offerings to cover more budget points, and there will be far more combinations with radio facilities. If past history of the industry is any criterion, you'll see Q-8 equipment prices moving downward, to a point where they will be only slightly higher than those of current two-channel Stereo 8 equipment. *Eventually*—just as the eight-track cartridge took over the field from the four-track cartridge—four-channel car tape players will replace today's two-channel models. This will be a "no-sweat" matter, in that Q-8 players accommodate existing two-channel Stereo 8 cartridges.

## Available 4-channel auto players

There are two basic types of surround-sound auto players in the marketplace. There is the compatible Q-8 4/2-channel model that plays Q-8 four-channel cartridges in the discrete mode through four channels of amplification and four speakers, and Stereo-8 two-channel cartridges via four amplifier channels and four speakers for a four-channel effect. Such models come with and without a synthesizer circuit, which some companies call a "matrix." The second is the so-called "matrix player," which derives a four-channel effect from two-channel cartridges via two channels of amplification and four speakers. Before you lay your money on the line, make sure that you know what you're buying.

For instance, if you heard a true Q-8 four-channel *discrete* player in a friend's car and he told you his rig cost \$150, don't think you'll best him with a \$59.95 "four-channel" player that your local friendly dealer is advertising on a huge banner plastered across his store window. A *matrix* four-channel car player—which plays only two-channel Stereo 8 cartridges, NOT four-channel Q-8—will cost substantially less than a discrete player, but it won't give you

the precise and distinctly separate channel effect that a discrete model offers. If a dealer tries to sell you a "four-channel 8-track" cartridge player for under \$70 and claims it is a discrete model, be suspicious; he may be trying to put something over on you. Or he, too, may be a victim of the misinformation and confusion rampant in the quadraphonic marketplace. We're not saying that a matrix car player won't give satisfactory surround-sound; what we're saying is, Don't expect to get discrete sound at matrix sound prices.

The lowest priced 2/4-channel surround-sound players—starting at about \$50—are two-channel Stereo 8 models with simple speaker phase-shift circuitry. They produce an enhanced double-stereo effect from four speakers that may satisfy many people looking for four-channel sound but not willing to pay a higher price. Such units will *not* play Q-8 tapes, unlike compatible 4/2-channel Q-8 models which additionally play two-channel cartridges. Again, check before you buy to know what you'll get in the way of compatibility/surround-sound.

Most Q-8 discrete players have the same basic features as regular two-channel players: volume and balance controls; track selector and indicator lights; and dust-proof cartridge openings. Some have additional features such as tone controls, fine tuning, fast-forward, repeat play, slide-in/slide-out anti-theft brackets, and one (in the Dyn line) even has a remote control. They all have a sensing device for four-channel/two-channel play determination. When a Q-8 tape is inserted, the device is activated to, in effect, direct the sound information from each track to a separate amplifier channel, for four distinct and different channels of sound. When a two-channel tape is inserted, the device triggers the unit to, in effect, divide the right-channel signal into right front and right back, and left-channel signal into left front and left back, for what could best be called double-stereo. If the model contains a synthesizer/matrix circuit, another effect is created—something that to a degree approximates discrete sound in terms of distinct, individual channel information. The degree depends on the amount of ambient sound information "hidden" in a particular cartridge.

At this point in time a certain amount of confusion about Q-8 is prevalent even at the manufacturer level. It is manifest in confused product descriptions in catalogues, brochures, and spec sheets. For example, one catalogue description of a Q-8 player says "four amplifiers give double power with regular cartridges," whereas in fact, two-channel tapes played on it play at the same total amplifier power as Q-8's, but through four speakers, rather than two as in conventional stereo. Some literature dilutes its selling

# add one of these



TWO- AND FOUR-CHANNEL PLAYER. Lafayette's 99 P 16065W.



QUADRALINE MODEL TM920S is 4-channel player by Motorola.

message by failing to indicate that a Q-8 unit also plays two-channel stereo cartridges.

You will also find product literature rather vague about certain details of quad operation. Most companies fail to indicate whether two-channel material is merely split between front and back, or if it is given a synthesizing/matrixing treatment in playback. In checking out a few of the vague descriptions, we found that some distributors and sales representatives handling auto players were also confused—unable to say with certainty that, for example, matrix models described as “2/4-channel 8-track” or as “Matrix 4-channel 8-track” could or could not play Q-8 cartridges in synthesized form rather than in discrete form. Some were not sure if their matrix units—as the term might suggest—actually decoded tapes, or synthesized their sound information for a derived four-channel effect. (In a way, this is a moot point since there are no matrixed four-channel cartridge tapes in the marketplace at this writing. A two-channel, non-matrixed tape played through a matrix model or through one with synthesizing circuitry, would sound virtually the same. Even a trained listener might not be able to hear a significant difference.)

Before you actually go out to buy a four-channel car player, we urge you to determine which store in your area handling such products has truly well-informed sales people. In checking sales literature, catalogue pages, or store ads before you go out to buy, do so with a lawyer's eye, to make sure the product descriptions don't create the impression that you're buying a Q-8 discrete player when in fact the “four-channel” cartridge player is actually a two-channel model that produces quasi-four-channel sound via four speakers.

The following companies produce Q-8 players that offer true discrete four-channel sound: Audiovox, Model C990; Automatic Radio, Model QME2445; Car Tapes Inc., Model CT18877; Channel Master, Model 6294; Craig, Model 3129; Dyn, Model DS905; Fulmer, Model (n.a.); Hammond Model HD585; Hitachi, Model CS4000; JVC, Models 1350, 1352, 1353; Lafayette, Model 99P16065W; Lear Jet, Model A245; Medallion, Model 65-540; Metro, Model MS9000; Mikado, Model Quad 8/4; Motorola, Model TM920S; Panasonic, Model CX601; Pioneer, Model QP444; RCA, Model 12R800; Realistic (Allied/Radio Shack) Model 12-1834; Sanyo, Model FT864; Sony, Model TC84; and Toyo, Models 721 and 722. The above sets also provide four-speaker surround-sound from two-channel cartridge tapes.

The following have matrix models that play regular two-channel cartridges in surround-sound through four

speakers: Audio Vox Model C910; Boman (div. of California Auto Radio), Models BM911, BM950, and BM1950 (with FM stereo radio); Hammond, Models HD525, and HD575 (with FM stereo radio); Hitachi, Model CS1440; Realistic (Allied/Radio Shack) Model 12-2024; and Sanyo, Models FT888, FT828, and FT867 (with AM/FM stereo).

One of the appeals of true quadrasonic car players is their relatively low cost vis a vis most home models. You can get a Q-8 discrete compatible 4/2-channel model for as little as \$89.95 in the Lafayette brand, for example, with a set of four speakers for an additional \$8.95, making your total investment just under \$100 exclusive of installation. Not bad for a complete system.

On the other hand, you can pay as much as \$169.95 for a Sony TC84, less speakers and installation. As we said earlier, there's a model for every budget, taste and need; no matter how large or how small.

If you still have reservations about 4-channel and currently have a two-channel player in your car, you can check out your feelings about the *concept* of four-channel sound before going “whole hog”, for under \$20.

Just as the home cartridge equipment field has its conversion units and quad adaptors, so too, does the auto player field. Several companies and mail-order catalogue houses offer four-channel simulators or synthesizers that enable you to hook into an existing two-channel cartridge unit to convert it to play (with the addition of two more speakers) surround-sound. These adaptors are priced from \$6.95. Some brands to check: Olson, Robins, Lafayette, Boman Astrosonix, Magnadyne, Allied/Radio Shack, and Sound Systems International.

What happens to the fellow who goes this route is that he is usually pleased with the 4-channel concept. When it comes time to plunk down his dough for a new all-in-one four-channel player, he is more likely to opt for a deluxe discrete model because he is sure that the benefits of 4-channel sound are well worth the extra investment in equipment.

## Installing the tape deck in a car

Auto player manufacturers have done their best to accommodate the do-it-yourselfer who prefers to handle his own player installation—to save money, or for the satisfaction of working with his hands. They have worked out detailed, fool-proof, step-by-step instructions on how to install a player that are easy enough for even a novice to follow to successful completion. In fact, some auto player suppliers say that 90 out of 100 fellows who can handle an electric drill and can tape wires can do a hang-on installa-



# tape players to your car



RADIO SHACK's Realistic model 12-1834.



RCA MODEL 12-R-800 Q-EIGHT tape player.

tion with ease, and that 75 out of 100 can do an in-dash installation in the space usually allotted for a car radio.

Further, the do-it-yourselfer is aided by the concept itself; since four speakers are used in a 4-channel ensemble and the space in which the units operate is relatively small, speaker placement is less critical than in a two-channel rig where two speakers are called on to fill the same space with a full, rich, open sound. Thus, you can utilize the many available hang-on and under-seat/above-deck speaker systems to make this aspect of a quad installation a cinch. Unless you're a sound "nut" or nth-degree perfectionist, you can get by nicely without having to cut out large holes in metal door panels for top quality sound in your car.

If you insist on built-in speakers for the front channels you still need not cut out door panels; instead, install them in the "kick" panels flanking the area under the dash. These panels are usually of an easy-to-cut material and are relatively easy to work with. Should you object to above-deck wedge speakers for rear channel use because they clutter the deck, you might investigate the use of built-ins—again, without worrying about cutting into steel. Some 90 per cent of today's cars have pre-cut speaker openings in the metal framework of the rear deck; it's just a matter of sawing through the covering material, usually fibreboard, to install the speakers. Before you go out to buy a four-channel car player, check your car trunk to see what sort of rear deck openings your particular car has; many were made to accommodate six by nine-inch oval speakers. Make your selection accordingly.

A word of advice about speaker quality comes from Ira Lash, sales manager for Audiovox, a major player producer. "If you use surface-mount speakers, go for the heavier magnet models. Try to match the quality of speakers, front with rear. If you have to compromise, install better speakers at the rear."

If doing-it-yourself is not your style, you can have a four-channel ensemble installed in your car economically—if you ask for the budget surface-mount approach as opposed to the "full treatment" of built-in speaker systems. The best place to go for an installation is to a specialist, rather than the fellow who handles car installations as an accommodation, or as an adjunct to a radio/TV/audio service setup. The specialist is likely to do the best job. Because he has the know-how and should know all the ins and outs of the trade, he'll probably do the job for less. Further, he won't foul up an installation, as the non-specialist might, when it comes to cutting into metalwork for built-in speakers.

R-E

## LIST OF MANUFACTURERS

- Audiovox Corp., 150 Marcus Blvd., Hauppauge, N.Y.
- Automatic Radio, 2 Main Street, Melrose, Mass. 02176
- Boman Astrosonix, 225 West Commercial Ave., Moonachie, N.J. 07074
- Car Tapes Inc., 9180 Kelvin Ave., Chatsworth, Calif. 91311 and 333 East Ontario St., Chicago 60610
- Channel Master Div. of Avnet, Inc., Ellenville, N.Y.
- Craig Corp. 921 W. Artesia Blvd., Compton, Calif. 90220 and 50-52 Joseph St., Moonachie, N.J.
- Dyn Electronics, Inc. 3095 N.W. 77th Ave., Miami, Fla. 33122 and 1111 East 14th St., Los Angeles, 90021
- Arthur Fulmer, 260 Monroe Ave., Memphis, Tenn.
- Hammond Sound Products, 9300 Hall Road, Downey, Calif.
- Hitachi Sales Corp., 48-50 34th Street, Long Island City, N.Y.
- JVC America, Inc., 50-35 56th Road, Maspeth, N.Y.
- Lafayette Radio Electronics, 111 Jericho Turnpike, Syosset, N.Y. 11791
- Lear Jet Stereo, Inc., 6868 South Plumer Ave., Tucson, Arizona 85706
- Magnadyne Corp., 9261 W. 3rd St., Beverly Hills, Calif.
- Medallion Automotive Products Co., P.O. Box 19043, Kansas City, Missouri 64141
- Metro Sound, 11144 Weddington St., N. Hollywood, Calif.
- Mikado Electronics, 1072 Bryant St., San Francisco, Calif. 94103
- Motorola, Inc., 9401 West Grand Ave., Franklin Park, Illinois 60131
- Olson Electronics, 260 S. Forge St., Akron, Ohio 44327
- Panasonic, 200 Park Ave., N.Y.C. 10017
- Pioneer Electronics of America, 1555 East Del Amo Blvd., Carson, Calif. 90746
- RCA/Parts and Accessories, 2000 Clements Bridge Rd., Deptford, N.J. 08096
- Realistic (Allied/Radio Shack), 100 N. Western Ave., Chicago 60680
- Robins Industries Corp., 15-58 127th St., College Point, N.Y. 11356
- Sanyo Electric Inc., 1200 West Walnut Street, Compton, Calif. 90220
- Sony (Superscope), 8150 Vineland Ave., Sun Valley, Calif. 91352
- Sound Systems International, 53 E. Oakland Ave., Salt Lake City, Utah 84115
- Toyo Radio Co. of America, Inc., 1611 Anderson Ave., Compton, Calif. 90220

# step-by-step

# TV TROUBLE

*Good sync is all-important  
sync-separator action is*

by ART MARGOLIS

THE SECRET TO SOLVING A SYNC trouble is in the approach. If confusion does occur, it's often because the technician has attacked the problem from the wrong angle. The sync-separator circuit is relatively simple, there are relatively few components. But what the circuit does is not simple at all. Understanding what happens to the sync signals in the sync separator helps turn a puzzling sync trouble situation into a quick repair.

The sync separator is fed a sample of the composite video signal taken off the video amplifier stages. The separator then snips the entire sync pedestal off the composite video, keeps the pedestal and discards the other parts of the signal.

The next horizontal and vertical sync pulses are separated from each other and fed to the horizontal and vertical oscillators.

## Typical transistor sync separator

**Dc setup**—The composite video signal applied to the base of the sync separator causes pulsing direct current flow through base resistor R6 due to rectifying action in the base-emitter junction. Current flow makes the base negative—or reverse-biased—with respect to the emitter. Capacitor C5 charges and tends to maintain the negative base bias.

The collector goes to +12 volts through R8 (2700 ohms). In normal operation, the drop across this resistor places the collector at +9 volts. A small stabilizing base bias is provided by R7 and R6. The collector feeds a pair of takeoff lines to the horizontal and vertical oscillator circuits. One is an integrator that extracts and shapes the vertical pulse. The other has an R-C network that shapes the horizontal pulses.

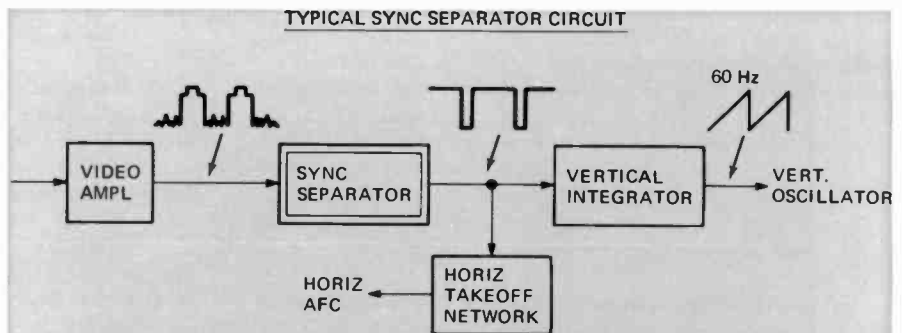
**Ac setup**—During the interval the video appears, the reverse bias prevents any conduction through the transistor. However the sync pedestals are considerably more positive in voltage than the video. They have enough

amplitude to override the reverse bias and turn on the transistor for the duration of the period.

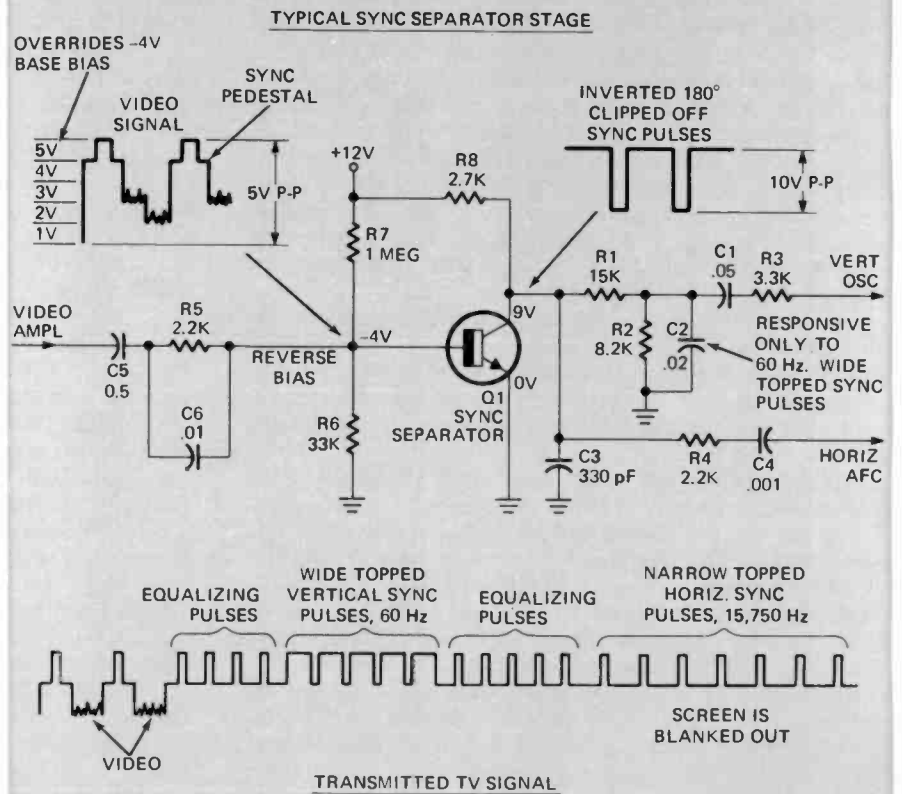
Collector current flows during the sync-pedestal interval so the sync pedestal is reproduced in the collector circuit where it appears amplified and inverted 180 degrees. The incoming

composite video signal can be about 6 volts peak-to-peak. The sync pulse in the collector circuit is about 10 volts peak-to-peak.

The clipped pulses on the collector are the square, narrow horizontal pulses occurring at a 15,750-hertz rate and the square wide vertical pulses oc-



BLOCK DIAGRAM (above) shows how the sync separator fits into the horizontal sync circuits of a modern TV receiver. TYPICAL SYNC-SEPARATOR CIRCUIT (below) is all solid state. The text presents a complete description of its operation.



# SHOOTER'S GUIDE

in black-and-white and color television. Proper essential. Here's how to make sure it works right

curing at a 60-hertz rate. The horizontal takeoff line responds to the horizontal pulses and sends them on to the horizontal oscillator.

The vertical integrator has a .02- $\mu$ F capacitor (C2) that can only charge up during the wide topped pulses. The wide pulses occur at a 60-hertz rate.

## INSIDE THE SYNC SEPARATOR

QUICK CHECK  
ATTACH VOLTMETER  
NORMAL VOLTAGES

TRY 4 CHANNEL SETTINGS	BIAS	COLLECTOR VOLTAGE
1 - COCK SELECTOR BETWEEN CHANNELS	SLIGHT POSITIVE	UNDER 5 VOLTS
2 - SET ON OFF CHANNEL	MINUS 2 VOLTS	ABOUT 6 VOLTS
3 - SET ON WEAK CHANNEL	APPROACHES MINUS 4 VOLTS	ABOUT 9 VOLTS
4 - SET ON STRONG CHANNEL	PRESCRIBED VOLTAGE	PRESCRIBED VOLTAGE

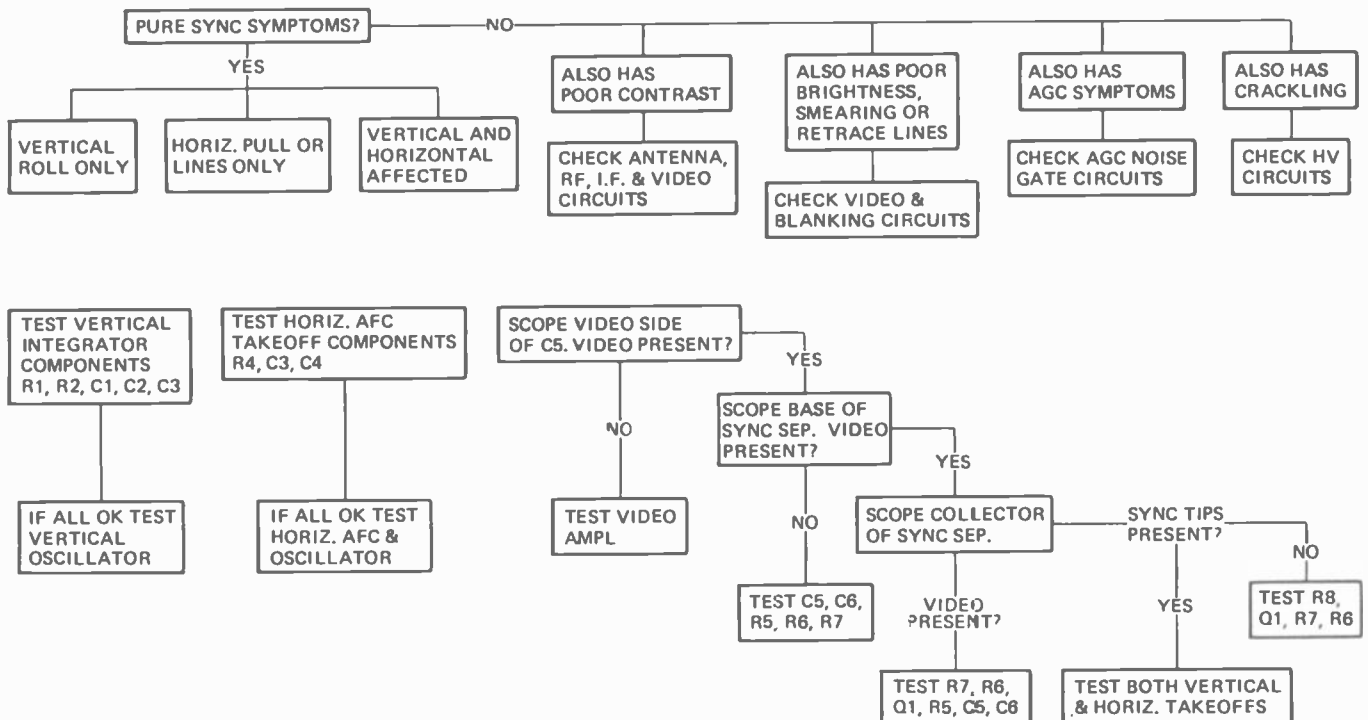
NORMAL VOLTAGES?

SYNC SEPARATOR Q1 & COMPONENTS OKAY

NOT NORMAL?

SYNC SEPARATOR HAS TROUBLE

TROUBLESHOOTING CHARTS help locate troubles fast. (above) Quick-check chart for use with voltmeter. (below) Detailed step-by-step troubleshooting procedure.



The C2's discharge becomes the properly shaped vertical sync pulse and is fed to the vertical oscillator.

## Sync separator trouble shooting

When the picture rolls, pulls or goes off into horizontal lines it is out of sync. The suspect circuits are many. Any circuit from the antenna, through the rf, i.f., video, sync to the sweep oscillators can contain the troublemaker. A closer analysis must be made to narrow the choice.

Even though the sync symptom is prominent, are there any other secondary symptoms? If there is also poor contrast, poor brightness, visible retrace, a smeared picture, age symptoms, incorrect lock in on a hold control, crackling, humming or buzzing, the trouble is probably not a sync problem. The trouble will probably be in the circuit the secondary symptom points out.

When there are no other symptoms, just sync, then the trouble will

probably be found in the sync circuit. If the sync is running both ways, horizontally and vertically then the separator itself or the surrounding components are prime suspects. Should the trouble be only vertical sync the vertical takeoff line is indicated. When the trouble is just horizontal, the horizontal takeoff line usually contains the defective component.

Once all the preceding conclusions are drawn the pinpointing of the actual component is simplified. With a scope follow the video from the video amplifier to the collector of the sync separator. As soon as you lose the correct pattern you have passed over the bad part.

**Quick check**—While the scope is the best approach in the sync stages, some quick checks are also handy to help isolate the section of the circuit.

The sync separator base bias and collector voltage are direct functions of the signal strength. Even though Q1 is reverse biased, some conduction is

taking place in the transistor. This is proved by the difference between the 12-volt supply and the 9 volts on the collector. There is a 3-volt drop across the 2700-ohm collector resistor.

Therefore if the reverse bias should fall to minus 1 the transistor will conduct more heavily and the collector voltage will drop below the 9 volts, due to the larger voltage drop across R8. If the bias should increase to minus 6 volts the transistor will conduct less and the collector voltage will rise toward the supply voltage.

Since the bias is a direct function of the signal strength, the transistor can be quick checked by changing the bias and noting if the transistor is acting normally or not.

Attach the voltmeter and try four different channel selector settings. One, cock the selector between channels. This is a relatively noise-free setting. The total lack of signal, not even any noise, does not let C5 charge up at all and the -4 volts bias disappears.

The base goes slightly positive and Q1 conducts heavily. The collector voltage drops way down, under 5 volts.

Two, set the selector on any unused channel. There is no signal, but there is plenty of snow or noise. The noise will charge up C5 a bit and could provide a bias of about -2 volts. As a result, collector voltage rises as transistor conduction is reduced. It could rise to about 6 or 7 volts.

Three, set the selector on a weak channel. The weak signal will charge C5 almost normally. The reverse bias approaches -4 volts and the collector rises, to 8 or 9 volts.

Lastly, set the selector to a strong local channel. Normal voltages should now appear.

This test takes much less time than reading about it. If normal voltages are present, Q5 and its components are operative. Should the sequence produce other than normal, attach the scope and pinpoint the defective leg.

R-E

## solid-state news

The Signetics Corporation (811 East Arques Ave., Sunnyvale, Calif. 94086) has introduced a new fully decoded 256 × 1 static random access memory (RAM), the type 25L01. Employing enhancement mode P-channel MOS devices integrated on a single monolithic chip, the new device is optimized for operation on +5 and -12 volt DC supplies, but also can be used on +5 and -9 volt sources. It has a guaranteed access time of only 1.0 μs. With a standby power dissipation of

just 100 μW/BIT, its access power dissipation is but 1.7 mW/BIT.

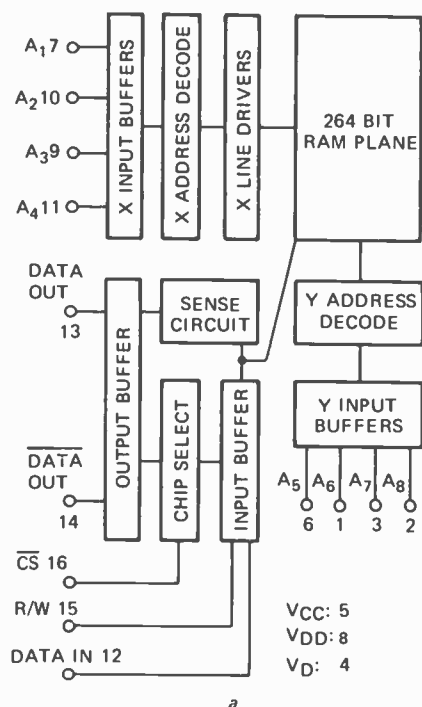
The 25L01 can be driven directly by standard TTL and DTL bipolar IC's, while its data output buffer is capable of sinking a minimum of 2.0 mA, sufficient to drive a standard TTL load. The new IC's internal block diagram is illustrated in Fig. 1-a, its pin connections given in Fig. 1-b. Packaged in a 16-pin silicone DIP, the 25L01 nets for only \$6.00 each.

With interest in digital displays

reaching boom levels, inexpensive new readout devices have been introduced by two major manufacturers: Fairchild's Semiconductor/Microwave and Optoelectronics Division (4001 Miranda Ave., Palo Alto, Calif. 94304), and Sperry Rand's Sperry Information Displays group (P. O. Box 3579, Scottsdale, Ariz. 85257).

Fairchild's new display is a ¼" high LED digit which utilizes a new and unique construction technique. Only one LED is used per display segment, with a molded plastic light pipe converting the spot of light into a uniform bar segment. A "fly's eye" lens consisting of multiple convex lenses on the display surface diffuses the light to provide bright displays with a viewing angle of 140°.

Sperry's new displays, Fig. 2, are seven-segment planar gas discharge devices designed specifically for interfacing with MOS/LSI circuits. Recommended for use in all dc or multi-



"B" PACKAGE

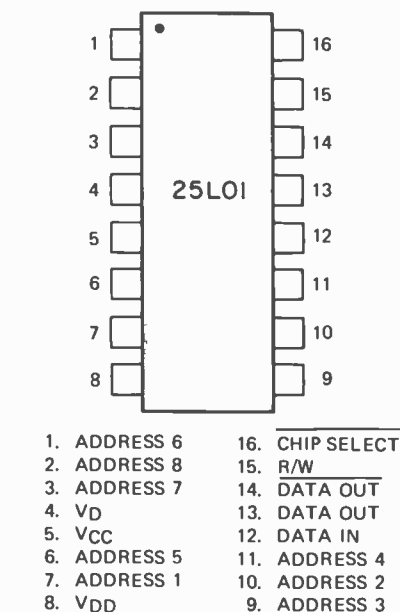


FIG. 1—BLOCK DIAGRAM (a) and pin connections (b) of Signetics' 25L01 RAM.



FIG. 2—SPERRY'S MOS/LSI compatible digital displays.

plexed applications, with or without suppressed zeros, the units are offered in two sizes, the SP-330 Series (½") and SP-350 Series (½").

R-E

# the state of

## SOLID STATE

*This month's glimpse into the world of semiconductors takes off with a glossary of terms so you too, can talk-that-talk.*

by LOU GARNER  
SEMICONDUCTOR EDITOR

SPECIALISTS LIKE TO USE TERMS AND expressions peculiar to their field. Frequently, these are acronyms of oft-repeated phrases or common, but longish, technical names. Sometimes they are coined words, adopted because there is no completely suitable term in the English language. In other cases, they are slang expressions appropriate to the equipment, process or technique described.

It follows, then, that logic circuit designers, manufacturers and engineers have their own lingo—their own stock of pet phrases and expressions. As a result, a technician, hobbyist, student, or engineer, no matter how well trained, skilled or experienced, may find himself lost in a maze of unfamiliar terms when he first starts working with digital circuits, especially if his past experience has been primarily with amplifiers, radio and TV receivers or transmitters, and similar types of equipment. At times, in fact, the novice to digital circuits may feel as if he is drowning in a vast bowl of alphabet soup or, at the very least, is a prisoner in an alphabet noodle factory.

For the benefit of those newcomers to the sometimes confusing but, nonetheless, logical field of digital logic, here is a brief review of the most common special expressions used and their basic definitions:

**A/D or AD:** With due respect to our own advertising department, this **AD** means *analog-to-digital*. Sometimes a third letter will be added to designate a particular circuit function. For example, the analog-to-digital converter used in a digital meter might be referred to as an **ADC** circuit.

**BCD:** Binary coded decimal.

**Bit:** A small role for actors, but, in logic technology, an abbreviation for binary digit.

**Chip:** Not off the old block, but a basic substrate without leads containing a single device or all the active and passive elements of a complete circuit . . . i.e., an uncased IC. Some manufacturers use transistor, diode and capacitor chips in the fabrication of hybrid circuits.

**Clock:** Some people watch these, but in digital work it's a pulse generator which controls the timing of counting, switching and memory circuits. Often, a simple multivibrator or relaxation oscillator.

**CML:** Current mode logic; logic circuits which operate in an unsaturated mode in contrast to types which operate in a saturated mode.

**CMOS:** Complementary (or complementary-symmetry) metal-oxide semiconductor. Used to identify devices manufactured of MOS materials and using complementary circuit configurations.

**COS/MOS:** See **CMOS**. Expression used primarily by RCA for its CMOS devices.

**D/A or DA:** Not "district attorney," but *digital-to-analog*. As in **A/D**, which we see, a third letter may be added to identify a specific circuit function. **DAC's** (digital-to-analog converters) are used in many control system designs.

**DCTL:** Direct-coupled transistor logic.

**DI/CMOS:** Expression used by Harris Semiconductor to identify its dielectrically isolated **CMOS** devices.

**DIP:** Slang expression for a pickpocket or a *dual in-line package*. If it's smaller than a breadbox and has metallic leads, it's the latter.

**D-MOS or D-MOST:** Designation used by the Signetics Corporation for a proprietary semiconductor manufacturing process and/or devices produced using the process; also, obsolete expression for "the greatest."

**DTL:** Diode-transistor logic.

**ECL:** Would you believe *emitter-coupled logic*?

**FEB:** If you were born in this month, your birthstone is the amethyst, but it's also an abbreviation for *functional electronic block*, a less common name for a monolithic integrated circuit.

**Gate:** Not to swing on, but the basic electronic switch used in digital logic; a circuit having two or more inputs and a single output, in which the output depends on the combination of input signals. Four basic types are used, identified according to the relationship between the input and output signals as . . . **AND, OR, NAND** and **NOR** gates.

**GIGO:** The expression sometimes used to describe poor digital equipment operation. It is an acronym for "Garbage In, Garbage Out." *Really!*

**Hybrid:** A type of corn as well as in-



tegrated circuits manufactured using a combination of discrete chips and thin film wiring.

**IC:** The common abbreviation for integrated circuit. *IC, do UC?*

**LSI:** Acronym for "large scale integration." Integrated circuits which may contain the equivalent of thousands of devices.

**McMOS:** Not a Scotsman, but the expression used by Motorola for its **CMOS** devices. See **CMOS**.

**MECL:** See **ECL**. Term used primarily by Motorola for its **ECL** devices.

**Memory:** A device or system into which digital information can be in-

serted and held for use at a later time. *Don't forget!*

**Monolithic:** Literally, "single stone." Could be one member of a rock group, but it's really used to identify complete integrated circuits formed on a single semiconductor chip.

**MOS:** Metal-oxide semiconductor. Often used in combination with other letters and/or acronyms to designate special devices as, for example, **MOS-FET**—metal oxide semiconductor field effect transistor. See **CMOS**, **D-MOS**, **NMOS**, **PMOS**.

**MSI:** Acronym for "medium scale integration." Integrated circuits which may contain the equivalent of scores or hundreds of devices. Without the

"I," used by Women's Lib.

**NMOS:** Designation for n-channel **MOS** devices.

**PMOS:** Guess? You're right—designation for p-channel **MOS** devices.

**PRAM:** If you're British, a baby buggy; in digital logic, a *programmable random access memory*.

**PROM:** Could be a dance if junior or senior, but used alone it's an acronym for *programmable read only memory*.

**RAM:** For our drinking friends, the symbol for bock beer . . . for Californians, a football player . . . and, in digital land, a *random access memory* (bet you figured that one out yourself).

**RCTL:** Resistor-capacitor-transistor logic; circuit in which logic functions are performed by resistors, with capacitors used to improve switching speed; a transistor serves as a buffer/inverter amplifier.

**ROM:** *Read only memory*; with an "E," a city in sunny Italy.

**RTL:** Resistor-transistor logic; similar to **RCTL**, but without the capacitors.

**TSL:** Acronym abbreviation for National Semiconductor's *Tri-State* logic devices.

**TTL, T<sup>2</sup>L or T2L:** Transistor-transistor logic. Not a stutter, but the designation used for certain logic devices employing multiple-emitter transistors.

**WHEW:** Not a digital term at all—just my reaction to finishing this list.

### SCR trigger circuits

Semiconductor manufacturers generally recommend that pulse signals be used to trigger SCR's for optimum performance in light dimmers, motor speed controls, power inverters, solenoid drivers and similar applications. Four suitable pulse generator circuits are illustrated in Fig. 1. All four were abstracted from GE application notes.

Perhaps the most popular pulse generator is the basic relaxation oscillator. A simple and inexpensive, but reliable, relaxation oscillator using a programmable unijunction transistor (PUT) is shown in Fig. 1-a. In operation, its repetition rate is established by timing control  $R_T$  in conjunction with timing range capacitor  $C_T$ . The output pulse is developed across a 22-ohm load resistor. A type 2N6027 may be used for the type DI3T1 PUT specified.

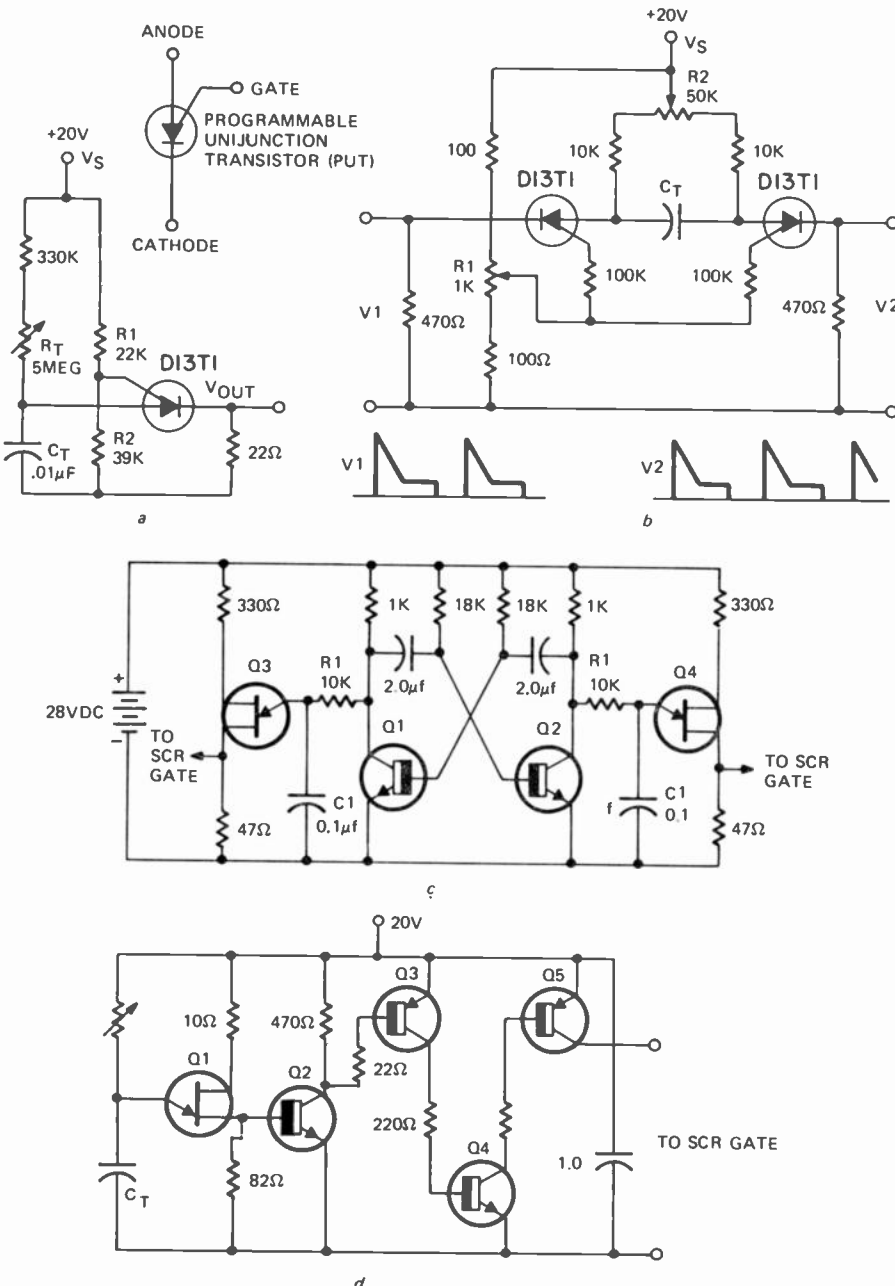


FIG. 1—PULSE GENERATOR CIRCUITS SUGGESTED by General Electric. A—PUT relaxation oscillator; b—Flip-flop trigger circuit; c—Pulse train circuit; d—High speed circuit.

The circuit in Fig. 1-b may be used when it is necessary to trigger two SCR's on alternate half-cycles as, for example, in a full-wave power inverter. Here, a pair of PUT's are used. The repetition rate is set by R2 in conjunction with timing range capacitor  $C_T$ .

In higher power applications, it is often desirable to drive the SCR's with a train of narrow pulses rather than a single broad pulse to reduce gate dissipation. This can be done with the circuit in Fig. 1-c. In operation, a collector-coupled transistor multivibrator, Q1-Q2, serves to gate a pair of UJT relaxation oscillators, Q3 and Q4, on alternate half-cycles. With the component values specified, this circuit delivers 1200-Hz pulse trains at a 50-Hz repetition rate.

Q1 and Q2 are 2N3416's. Q3 and Q4 are 2N2647's. If the circuit is used on dc source voltages of less than 25 volts, use 2N3414's for Q1 and Q2.

Where high-speed operation is needed, the circuit in Fig. 1-d may be used. Featuring a UJT relaxation oscillator, Q1, followed by a four-stage direct-coupled transistor amplifier, Q2 to Q5, this circuit can generate rectangular pulses of 10- $\mu$ s width at repetition rates of up to 20 kHz, depending on the values of the UJT's timing resistor and capacitor. Q1 is a 2N2647, Q2 and Q4 are 2N3414's, Q3 is a 2N5365, and Q5 is a D43.

### Product/device news

Interdesign, Inc. (1190 Elko Drive, Sunnyvale, Calif. 94086) has announced a third addition to their series of general-purpose IC chips. Designated Monochip C, the new chip, Fig. 2, contains 110 integrated com-

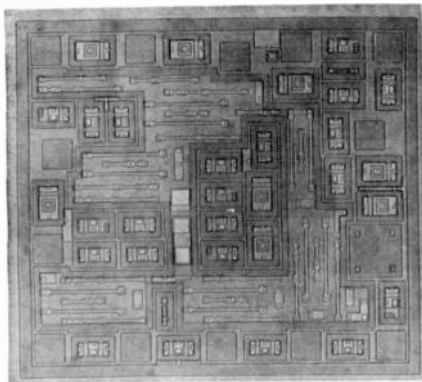


FIG. 2—INTERDESIGN'S MONOCHIP C general-purpose IC chip.

ponents and 14 bonding pads, comprising 23 npn transistors, 8 pnp transistors, 6 Schottky diodes, and 73 resistors. Used in conjunction with the firm's model MO-K Design Kit, which nets for \$39.00, the Monochip devices permit an engineer or skilled technician to design his own custom IC's.

A series of glass passivated thin-

film resistors suitable for use in hybrid circuits has been announced by the new Hybrex Division of the Burr-Brown Research Corporation (6730 S. Tucson Blvd., Tucson, Ariz. 85706). Named the "S" series, the new units, illustrated in Fig. 3, offer standard

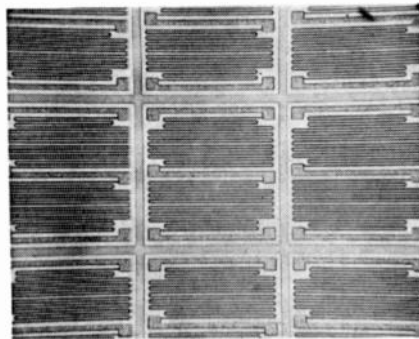


FIG. 3—HYBRESX'S "S" SERIES thin-film resistors for hybrid circuits.

temperature coefficients of less than  $\pm 50$  ppm/ $^{\circ}$ C. Standard resistance values are available from 10 ohms to 511,000 ohms with 1% tolerance; from 10 ohms to 510,000 ohms with 5% tolerance; from 10 ohms with 10% tolerance.

All have a power dissipation rating of 250 mW. Tighter tolerances and higher resistance values are available in custom types. Offered in both chip and wafer form, the "S" series resistors are priced at 59 cents each for 10% tolerance types in medium quantities.

Another interesting hybrid circuit component has been introduced by the San Fernando Electric Manufacturing Co. (1501 First St., San Fernando, Calif. 91341)—would you believe a monolithic ceramic chip inductor? It's true! Dubbed *Magnachip*, the device is manufactured from a proprietary ferrite formulation that is dispersed in plastic, cast to a uniform film, and then printed with conductive ink. A process of stacking, interconnection, lamination, and firing is used to produce the final devices, which are small, solid, dense, multilayer inductances. Standard inductance ranges are from 0.2 to 5  $\mu$ H with a minimum Q of 20. The units have a series resistance of 0.5 ohms maximum, a power rating of 0.3 watt, and a current rating of 1.0 amperes.

"Not another function generator IC," was my initial reaction when I first learned of Intersil's (10900 No. Tantau Ave., Cupertino, Calif. 95014) new 8038 Voltage-Controlled Oscillator. Upon closer examination, however, I found that the new device has a lot to offer. It works with any 10 to 30-volt or  $\pm 5$  to  $\pm 15$ -volt dc supply. It can furnish high-level sine, triangular and square waves simultaneously (Fig. 4) from 0.001 Hz to 1.5 MHz, and its output can be swept or

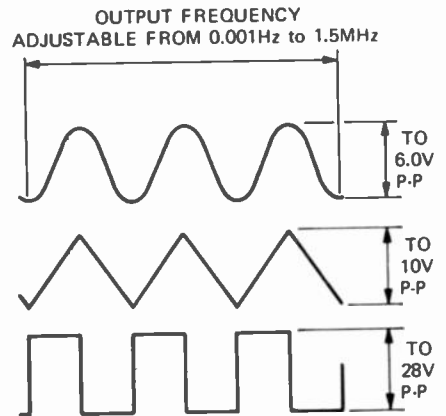


FIG. 4—WAVEFORMS AVAILABLE from Intersil's 8038 IC voltage controlled oscillator.

FM'd up to 100 kHz. Its square-wave duty cycle is adjustable from 2% to 98% and it has a typical stability of 50 ppm/ $^{\circ}$ C. But its best "spec" is its price—packaged in a plastic DIP, the 8038CC nets for only \$3.75 each in unit quantities!

Intended for use in miniature, battery-powered equipment, such as hand-held calculators and portable test instruments where power and space are limited, HP's new displays are 7-segment monolithic units 0.11 inch high. The devices are available in 3, 4 and 5-digit clusters with either the standard right-hand decimal point or a centered decimal, as illustrated in Fig. 5. End-stackable, the units feature built-in magnification which increases the apparent luminous intensity, thus reducing power requirements.

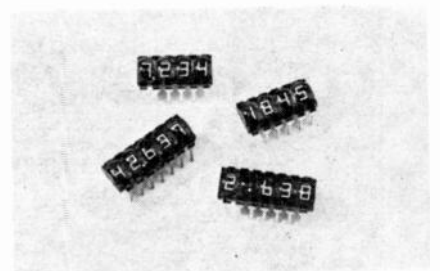


FIG. 5—HEWLETT-PACKARD'S new LED displays.

Identified as the Model 5082-7400 series, the new HP displays are packaged in standard 12 (3 and 4 digits) or 14 (5 digits) pin DIPs which can be plugged into conventional sockets or soldered directly into PC boards. The shoulders of the lead frame pins are intentionally raised above the bottom of the packages so the displays can be tilt-mounted up to 20 $^{\circ}$  from PC boards. A red dye is incorporated in the plastic lens to filter out visible light other than red and thus to improve contrast.

Unit prices for the 5082-7400 devices range from a mere \$12.75 for a 3-digit cluster to \$21.25 for a 5-digit cluster. Quantity prices are lower, of course.

R-E

# RCA Institutes introduces the CASSETTE SYSTEM

## **It's almost like having an instructor in your own home.**

Now, another breakthrough from the company that brought you AUTOTEXT, RCA's step-by-step home learning method! It's the new RCA Institutes' CASSETTE SYSTEM, an innovative learning-by-hearing approach designed to get you started more quickly and easily towards an electronics career. The CASSETTE SYSTEM adds an extra dimension to AUTOTEXT, RCA's step-by-step planned instruction which simplifies the mechanics of learning. As you play the cassette tapes, you'll have an instructor guiding you through your AUTOTEXT lessons. Explaining the material as you read it. Going over schematics with you, reinforcing the basic electricity and electronics study materials. All in an easy-to-understand conversational tone. And now the CASSETTE SYSTEM is available as an optional extra to all students enrolling in basic, fundamental, and career programs.

### **"HANDS-ON" TRAINING**

In addition, you get the all-important "Hands-On" training, an enjoyable as well as instructive part of many RCA Institutes courses and programs. You will perform experiments and build a number of pieces of electronics test equipment that you can keep and use. In the Master TV/Radio Servicing program you build and keep an all solid-state black & white TV set, a color TV set, oscilloscope and multimeter. With the addition of tape cassettes, you get an expert personal touch that can unravel the complexities of basic electronics.

### **CHOOSE FROM EXCITING CAREERS**

Whether your career goal is Radio/TV Servicing, Digital Technology, Communications or Industrial Electronics, RCA Institutes has the course or career program that can lead to it. The RCA way gets you started towards that exciting career with the training you might have thought was too expensive, too drawn-out, or too hard to learn.

### **NO SALESMAN WILL CALL**

If you're interested in an exciting rewarding career in electronics, send the attached card or fill in the coupon. We'll send you all the information you'll need to discover which RCA course or program is for you. No salesman will call.

Don't let this opportunity to find out about RCA Institutes' training for an electronics career pass you by. The sooner you write, the closer your new electronics career may be.

# An exciting concept - - new in RCA Institutes' electronics home training



In the Master TV/Radio Servicing Program, you build and keep the all solid-state black and white TV set, the color TV set, the oscilloscope and multimeter shown above.

## **RCA** Institutes

758-303-0

RCA Institutes, Inc.  
Home Study Dept.  
320 West 31st Street, New York, N. Y. 10001  
Please rush me FREE illustrated catalog.  
I understand that I am under no obligation.

Name \_\_\_\_\_ Age \_\_\_\_\_  
(please print)

Address \_\_\_\_\_

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

Check here if interested in Classroom Training   
Veterans: Check here

# hard rock's high dB's— and your hearing

Music soothes? Not if it is hard rock with amplifiers going full blast. It's dangerous and hurts. Here's how

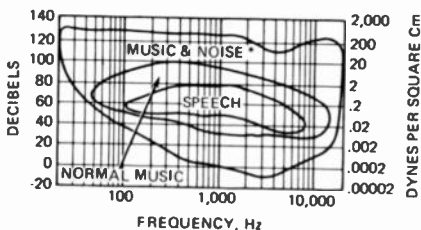
by MERINO y CORONADO

GUITARS COUPLED TO 100-WATT AMPLIFIERS, combo organs delivering 200 watts and accordions provided with pickups and high-power amplifiers are "in" on the rock scene today. Amateur and professional rock groups are engaged in a wattage war: 50-watt amplifiers are quickly replaced by monsters of 200 watts or more, and the technology of modern loudspeakers make it possible to operate them continuously at high levels.

When it was found some discotheques operate with sound levels of 90 dB and up, doctors and psychologists began to worry about the effects these music levels may produce on the delicate human inner ear. Several medical and technical publications published articles on the subject, and I decided to make some measurements myself.

## Frequency and intensity limits

Textbooks say that the audible frequency range lies between 20 and 20,000 Hz. This is not the case in Mexico. Some time ago, a study with several hundred workers of the Mexican Railways System revealed that the audible range of these people goes from 35 to 15,200 Hz. These results agree closely with what I obtained with some 150 of my students in the School of Electrical Engineering.



\* MUSIC AT HIGH VOL. & LOW FIDELITY

FIG. 1—STANDARD AUDIOGRAM with frequencies and intensities found in ordinary speech and normal music. Sounds with both parameters located under the outer line are inaudible. Sounds over some 130 dB cause discomfort or damage to the ear.

For Mexico, the normal or standard audiogram must be modified accordingly. But for the moment, let's look at a standard audiogram such as Fig. 1 (reproduced from the June 1934 *Bell Laboratories Record*). This shows

the frequency and volume ranges of speech and orchestral music, as well as ordinary sound.

The outer line depicts the boundaries of "normal hearing," that is, the upper and lower limits of intensity and frequency. For example, a sound of 100 Hz becomes inaudible when its intensity falls below about 38 dB. But the same sound must have an intensity of more than 50 dB but less than 90 dB if it is to be musically useful, as shown by the first inner line. The innermost line is for speech.

Notice the threshold of hearing is 0 dB at 1,000 Hz, but is about -10 dB at 3,000 Hz, the frequency at which the human ear is most sensitive.

## Sound that hurts

The upper portion of the curve, the threshold of "feeling," is practically flat for all frequencies. Sounds stronger than 120-130 dB are not "heard," but "felt" by the human ear: a "tactile sensation" is experienced and discomfort begins. Pain is experienced at 140 dB, but it is well known that prolonged exposure to sound levels of 100 dB in some instances (and even 80dB at certain frequencies) may result in permanent, irreversible damage to the inner ear.

A number of representative noise levels are shown in the table below.

## REPRESENTATIVE NOISE LEVELS

Db	Source of Sound
0	Threshold of hearing
10	Whisper at one meter
20	Extremely quiet room
30	Whisper at two meters
40	Conversation, low voice
50	Ordinary office or home
60	Expressway traffic
70	Heavy street traffic
80	Pneumatic drill at 15 meters
90	Printing plant
100	AVERAGE GO-GO MUSIC
110	Piston airplane engine
120	Discomfort begins
130	Jet take-off at 60 meters
140	Threshold of pain
150	Damage to the ear
160	Destruction of the ear

Different machines produce different sound levels, as every acoustic or industrial engineer knows. But what about go-go music?

It is well known that a symphony orchestra can produce sound levels around 100 dB during certain fortissimo passages, but most of the time its ability to produce high-intensity sounds is considerably reduced. Since I knew nothing about sound intensity of go-go and rock music, I measured the levels at three or four discotheques and four or five "well-designed" go-go night clubs. To my surprise, I found constant levels of between 90 and 100 dB. That is more than the noise intensity found in the plant where this magazine was printed!

In some night clubs the musicians play on a stage and their amplifiers and loudspeakers are also located there. Customers can select a place to sit away from the sound sources when they're not dancing. But in "well-designed" discotheques, loudspeakers are distributed across the room. A constant and equal sound level is found in every square meter of dancing or sitting space. There is no way to escape this Niagara of sound.

## Go-go audlograms

Recently I organized a go-go party with about 40 of my students

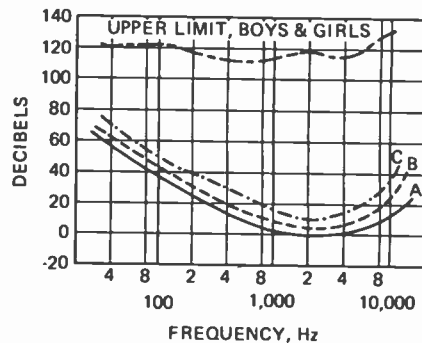


FIG. 2—HEARING LOSS after three hours of a go-go music. Line A is the mean audiogram for both boys and girls before the party. Line B shows the hearing loss for girls; Line C shows the hearing loss for boys.

under controlled conditions. An audiogram for each was made before the party, and the music was carefully se-

(continued on page 89)



# R-E's Service Clinic

## The "funny button"

*Automatic picture control at the push of a button*

by JACK DARR  
SERVICE EDITOR

THE BOYS IN THE BACK ROOM HAVE come up with another "new" one for us. Nothing really new, of course, just a different application of things we've been using all along. This is showing up in more and more sets all the time, so I thought it would be a good idea to kick it around for a while. Mostly an advertising gimmick, it can be very helpful (especially with *some* of our customers!)

This is the *Magic Button*. One company's engineers call it the *Funny-Button!* Motorola calls it *INSTA-MATIC*, Zenith calls it *CHROMATIC TUNING*, and others have their own semantic tricks with it. The idea of the whole thing is to let the customer correct for accidental misadjustment of controls (kids, brothers-in-law, etc.) by simply pushing one button. The picture then comes in perfectly adjusted.

Basically, it's simple. The funny-button is just a multiple-contact switch. When it is pushed, several of the regular controls are completely disconnected, and preset controls switched into their place. The number of these varies. In some sets, this is actually nothing but the aft switch. In others, such as the Motorola TS-929 Quasar II chassis, the brightness, contrast, hue and color controls, as well as the aft, are switched.

In *INSTA-MATIC* position, the front panel controls are disconnected. The preset controls are mounted on the top rail of the chassis, accessible from the outside in most models. When you install one of these sets, you tune it up for the best picture, color, etc. Then, switch to *INSTA-MATIC*, and adjust the preset controls to get exactly the same picture quality. Check with the owner, so the picture is set to what he or she likes best.

In the Motorola chassis just mentioned, beside the controls already mentioned, an *AUTOMATIC TINT CONTROL* is switched in. It changes the demodulation angle, making it just a little wider than the regular 90°, to give "improved flesh tones." The red video level is slightly raised to give

the picture a "warmer" tone. The acc circuit is also in on *INSTA-MATIC*, to help hold the color-level constant. This is a great help during commercials, etc., old movies and such things where color levels may change drastically.

In the new Zenith D-line chassis, the funny-button is called *CHROMATIC TUNING*. It switches in presets for color, tint, contrast, brightness, and aft. Here, the preset controls are in the form of duals, each one mounted behind the regular front-panel control for the same function. To set these up, adjust as before, for the best picture. Then pull the knobs off, and push the *CHROMATIC TUNING* button. The presets are adjusted with a special wrench; one of these comes with each set, in the instruction manual. (It has been recommended that the installing technician quietly snitch this wrench out of the book, to keep the customer out of them!)

The *CHROMATIC TUNING* switch is a square pushbutton on the front panel. In some it's a push-on, push-off switch, in others a push-pull type. In both of them, a pilot light inside the pushbutton glows a bright orange, to indicate that the set is in automatic tune position. (This could save several nuisance calls on new sets. If the owner complains that none of the front panel controls work, ask him to check and see if this pushbutton switch is lit.)

RCA uses a double-button system. Since these are side by side, anyone with a fat finger can push both at the same time, and get "one-button" control. One is the aft, and the other is the acm for *AUTOMATIC COLOR MONITOR*. They call the whole thing *ACCU-MATIC*.

Here again, the automatic controls are set up to make a good color picture, comparing it with one tuned in with the acm off. Two controls are used, for color and tint. Unlike the "full-disconnect" circuit used in others, the RCA circuit still leaves a little range of adjustment for both color

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. Don't forget to enclose a stamped, self-addressed envelope. Write: Service Editor, Radio-Electronics, 200 Park Ave. South, New York 10003.

# If you're not using IR's "Functional Fifty" Universal Transistors, the odds are 800-to-1 you're wasting time and money!

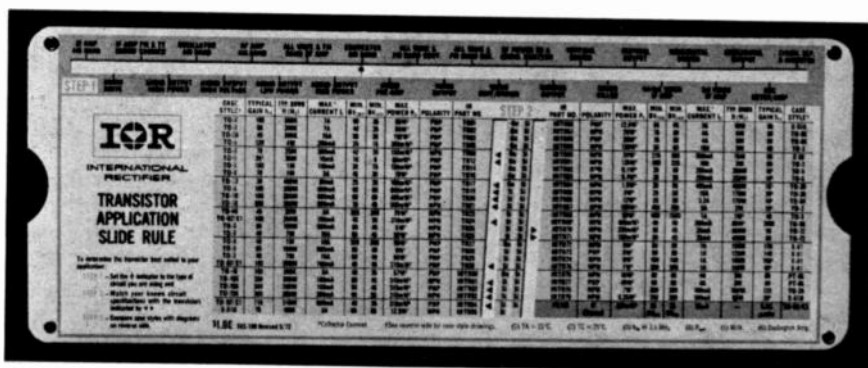
We boiled over 40,000 transistors down to a universal product line just under 50, an 800-to-1 reduction. This "Functional Fifty" lets you satisfy 99% of your functional requirements, faster and easier. It cuts down the time-eating task of searching for exact replacements, locating special sources, then waiting for delivery.

You'll save more money too, by getting IR's 20%-off-net-pricing on a 10-piece purchase, instead of the 10% offered by other brands. And, you're assured of premium quality,

because all IR transistors are conservatively rated to give reliable performance with extra margins of safety.

To make your job even simpler, we're offering a Transistor Applications Slide-Rule that lets you quickly pick the right transistor for your application.

GET YOUR IR "SLIDE-RULE". Remember to ask for the TAS-100 Transistor Application Slide-Rule the next time you visit your local IR supplier. Switch to International Rectifier's "Functional Fifty" and make the odds work in your favor.



**INTERNATIONAL RECTIFIER** 

Semiconductor Division, 233 Kansas Street, El Segundo, California 90245, Phone (213) 678-6281

Circle 20 on reader service card

70 RADIO-ELECTRONICS • MARCH 1973

and tint, for customer preference. So if you notice that the color and tint controls do not seem to have enough range, check to be sure that the acm button is *not* pushed in. It also produces a slight shift in demodulator angle to enhance the red in flesh tones.

These things could be of quite a bit of help to us, especially in making preliminary diagnoses. If there is a picture, with any kind of trouble symptoms, just push the *Funny-Button* and see if this straightens things up. If you still have the same troubles, *then* you go dig in the chassis to find out what's going on.

There is also the possibility of *both* normal controls and funny-button being incorrectly adjusted. **R-E**

## reader questions

### LOW VOLUME

*I've got very low volume in this GE T2NA stereo amplifier. The dc supply voltage is normal, about +15 volts, on the collectors, but I can't get any dc voltage at all at the common emitters of the output transistor pair.*

*Also, I broke one of the bias regulator diodes, and I can't find a number for it as a substitute. Original is EA-1405.—J.K. Wellsville, Ohio*

It sounds very much as if your two "top" transistors in the output pair are both *open* ('top' transistor is the one connected to the dc supply). If this happens, they won't conduct, and you'd have no dc voltage at the midpoint of the circuit as you should. Take them out and check; you'll probably find the emitter-collector junction open. Replace both of them at once, in each pair, so that they'll be matched.

This bias diode should be of the same material as the output transistors; silicon, here. An RCA SK-3100 should work.

### THE BACKWARD SCREENS

*I've got no raster on this Zenith 20Y1C50. However, the high voltage reads 25 kV, and the pix tube checks good. All of the dc voltages on the pix tube are normal except the screens. They read only +300 volts. The weird part is when I turn the screen controls; turning them clockwise, the screen voltages go down!—V.D.R. Helena, Mont.*

You've got a problem in the B++ or boost-boost rectifier circuit. In this same chassis, I have found the 68K series resistor practically open, and the B++ rectifier open at the

(continued on page 78)

# R-E's Substitution Guide for replacement transistors

compiled by ROBERT & ELIZABETH SCOTT

This Universal Transistor Substitution Guide is being compiled to help those experimenters, hobbyists and service technicians who are hard-pressed to find the transistor needed to complete a project or a servicing job. It lists the interchangeability between JEDEC and EIA (standard) type numbers and the universal replacement-type solid-state devices made by eight of the leading semiconductor manufacturers. This month we list replacements for about 200 standard transistor types in numerical order, beginning with the 2N23. In following months, we'll bring you more in an easy-to-use form that you can clip and file in a notebook where it will always be handy. 2N numbers not listed are devices for which no replacements are available.

R-E's Transistor Substitution Guide is a compilation of material abstracted from the substitution guides of eight leading semiconductor manufacturers and distributors. These are:

ARCH—Indicates the Archer brand of semiconductors sold only by Radio Shack and Allied Radio stores. Allied Radio Shack, 2725 W. 7th St., Ft. Worth, Texas 76107

G-E—General Electric Co., Tube Product Div., Owensboro, Ky. 42301

IR—International Rectifier, Semiconductor Div., 233 Kansas St., El Segundo, California 90245

MAL—Mallory Distributor Products Co., 101 S. Parker, Indianapolis, Ind. 46201

MOT—Motorola Semiconductors, Box 2963, Phoenix, Ariz. 85036

RCA—RCA, Electronic Components, Harrison, N.J. 07029

SPR—Sprague Products Co., 65 Marshall St., North Adams, Mass. 01247

SYL—Sylvania Electric Corp., 100 1st Ave., Waltham, Mass. 02154

Radio-Electronics has done its utmost to insure that the listings in this directory are as accurate and reliable as possible; however, no responsibility is assumed by Radio-Electronics for its use. We have used the latest manufacturers material available to us and have asked each manufacturer covered in the listing to check its accuracy. Where we have been supplied with corrections, we have updated the listing to include them.

	ARCH	G-E	IR	MAL	MOT	RCA	SPR	SYL
2N23	NA	GE-52	TR-05	PTC 102	NA	SK 3004	RT-120	ECG 102
2N24	NA	GE-1	TR-14	PTC 109	NA	SK 3004	RT-120	ECG 102
2N25	NA	GE-52	TR-05	PTC 102	NA	SK 3004	RT-120	ECG 102
2N26	NA	GE-1	TR-14	PTC 102	NA	SK 3004	RT-120	ECG 102
2N27	RS276-2004	GE-1	TR-05	PTC 102	HEP-253	SK 3005	RT-118	ECG 100
2N28	RS276-2002	NA	TR-08	NA	HEP-641	SK 3011	RT-119	ECG 101
2N29	RS276-2002	NA	TR-08	NA	HEP-641	SK 3011	RT-118	ECG 101
2N30	NA	GE-51	TR-05	PTC 107	NA	SK 3005	RT-118	ECG 100
2N31	NA	GE-51	TR-05	PTC 107	NA	SK 3005	RT-118	ECG 100
2N32	RS276-2004	GE-1	TR-14	PTC 109	HEP-253	SK 3004	RT-120	ECG 102
2N33	NA	GE-51	IRTR-89	PTC 107	HEP-2	SK 3006	NA	ECG 126
2N34	RS276-2005	GE-2	IRTR-85	PTC 108	HEP-254	SK 3004	RT-121	ECG 102A
2N34A	RS276-2005	GE-2	IRTR-85	PTC 108	HEP-254	SK 3004	RT-121	ECG 102A
2N35	RS276-2001	GE-8	IRTR-85	PTC 108	HEP-641	SK 3010	RT-122	ECG 103A
2N36	RS276-2004	GE-2	IRTR-85	PTC 107	HEP-253	SK 3003	RT-121	ECG 102A
2N37	RS276-2004	GE-2	IRTR-85	PTC 107	HEP-253	SK 3003	RT-121	ECG 102A
2N38	RS276-2004	GE-2	IRTR-85	PTC 107	HEP-253	SK 3003	RT-121	ECG 102A


Note: NA = Not Available

	ARCH	G-E	IR	MAL	MOT	RCA	SPR	SYL
2N38A	RS276-2004	GE-2	IRTR-85	PTC 107	HEP-253	SK 3003	RT-121	ECG 102A
2N39	RS276-2005	GE-2	TR-05	PTC 102	HEP-254	SK 3004	RT-120	ECG 102
2N40	RS276-2005	GE-2	TR-05	PTC 102	HEP-254	SK 3004	RT-120	ECG 102
2N41	RS276-2005	GE-2	TR-05	PTC 102	HEP-254	SK 3003	RT-120	ECG 102
2N42	RS276-2005	GE-2	TR-05	PTC 102	HEP-254	SK 3003	RT-120	ECG 102
2N43	RS276-2005	GE-2	IRTR-85	PTC 134	HEP-254	SK 3004	RT-120	ECG 102
2N44	RS276-2004	GE-2	IRTR-85	PTC 134	HEP-253	SK 3004	RT-120	ECG 102
2N44A	RS276-2004	GE-2	IRTR-85	PTC 134	HEP-253	SK 3004	RT-120	ECG 102
2N45	RS276-2004	GE-2	IRTR-85	PTC 109	HEP-253	NA	RT-121	ECG 102A
2N46	RS276-2005	GE-2	IRTR-85	PTC 109	HEP-254	SK 3004	RT-120	ECG 102
2N47	RS276-2005	GE-2	IRTR-85	PTC 102	HEP-254	SK 3004	RT-120	ECG 102
2N48	RS276-2004	GE-2	IRTR-85	PTC 102	HEP-253	SK 3004	RT-120	ECG 102
2N49	RS276-2005	GE-2	IRTR-85	PTC 102	HEP-254	SK 3004	RT-120	ECG 102
2N50	RS276-2005	GE-52	IRTR-85	PTC 102	HEP-254	SK 3004	RT-120	ECG 102
2N51	RS276-2005	GE-52	IRTR-85	PTC 102	HEP-254	SK 3004	RT-120	ECG 102
2N52	RS276-2004	GE-52	IRTR-85	PTC 109	HEP-253	SK 3004	RT-120	ECG 102
2N53	NA	GE-52	IRTR-85	PTC 102	NA	SK 3004	RT-120	ECG 102
2N54	RS276-2005	GE-2	IRTR-85	PTC 102	HEP-254	SK 3004	RT-120	ECG 102
2N55	RS276-2004	GE-2	IRTR-85	PTC 102	HEP-253	SK 3004	RT-120	ECG 102
2N56	RS276-2004	GE-2	IRTR-85	PTC 102	HEP-253	SK 3004	RT-120	ECG 102
2N57	NA	NA	TR-27	NA	NA	NA	NA	NA
2N58	NA	NA	IRTR-85	NA	NA	NA	NA	NA
2N59	RS276-2005	GE-2	IRTR-85	PTC 102	HEP-254	SK 3003	RT-120	ECG 102
2N60	RS276-2005	GE-2	IRTR-85	PTC 102	HEP-254	SK 3003	RT-120	ECG 102
2N61	RS276-2005	GE-2	IRTR-85	PTC 102	HEP-254	SK 3003	RT-120	ECG 102
2N62	RS276-2005	GE-2	IRTR-85	PTC 109	HEP-254	SK 3004	RT-121	ECG 102A
2N63	RS276-2004	GE-2	IRTR-85	PTC 109	HEP-253	SK 3003	RT-121	ECG 102A
2N64	RS276-2005	GE-2	IRTR-85	PTC 109	HEP-254	SK 3003	RT-121	ECG 102A
2N65	RS276-2005	GE-2	IRTR-85	PTC 109	HEP-254	SK 3003	RT-120	ECG 102
2N66	NA	NA	TR-27	NA	NA	NA	NA	NA
2N67	NA	NA	TR-27	NA	NA	NA	NA	NA
2N68	NA	NA	TR-27	NA	NA	NA	NA	NA
2N71	NA	GE-52	IRTR-85	PTC 102	NA	SK 3004	RT-120	ECG 102
2N72	NA	GE-1	IRTR-89	PTC 109	NA	SK 3006	NA	ECG 126
2N73	NA	GE-52	IRTR-85	PTC 102	NA	SK 3004	RT-120	ECG 102
2N74	NA	GE-52	IRTR-85	PTC 102	NA	SK 3004	RT-120	ECG 102
2N75	RS276-2004	GE-51	IRTR-89	PTC 107	HEP-250	SK 3006	NA	ECG 126
2N76	RS276-2004	GE-2	IRTR-85	PTC 107	HEP-253	SK 3004	RT-120	ECG 102
2N77	RS276-2005	GE-2	IRTR-85	PTC 107	HEP-254	SK 3004	RT-120	ECG 102
2N78	RS276-2001	GE-6	IRTR-08	PTC 108	HEP-641	SK 3011	RT-119	ECG 101
2N79	RS276-2005	GE-2	IRTR-85	PTC 102	HEP-254	SK 3004	RT-120	ECG 102
2N80	RS276-2005	GE-2	IRTR-85	PTC 107	HEP-254	SK 3004	RT-120	ECG 102
2N81	RS276-2004	GE-2	IRTR-85	PTC 109	HEP-253	SK 3003	RT-120	ECG 102
2N82	RS276-2005	GE-2	IRTR-85	PTC 109	HEP-254	SK 3003	RT-120	ECG 102
2N83	RS276-2006	GE-1	IRTR-85	NA	HEP-232	SK 3003	RT-118	ECG 100
2N84	NA	NA	IRTR-85	NA	HEP-2	NA	NA	NA
2N85	NA	NA	IRTR-89	NA	HEP-2	SK 3006	NA	ECG 126
2N86	NA	NA	IRTR-89	NA	HEP-2	SK 3006	NA	ECG 126
2N87	NA	NA	IRTR-89	NA	HEP-2	SK 3006	NA	ECG 126
2N88	NA	NA	IRTR-89	NA	HEP-2	SK 3006	NA	ECG 126
2N89	NA	NA	IRTR-89	NA	HEP-2	SK 3006	NA	ECG 126
2N90	NA	NA	IRTR-89	NA	HEP-2	SK 3006	NA	ECG 126
2N94	RS276-2002	GE-6	TR-08	PTC 108	HEP-641	SK 3011	RT-122	ECG 103A
2N96	RS276-2004	GE-2	IRTR-85	PTC 102	HEP-253	SK 3004	RT-120	ECG 102
2N97	RS276-2001	GE-7	TR-08	PTC 108	HEP-641	SK 3011	RT-119	ECG 101
2N98	RS276-2001	GE-7	TR-08	PTC 108	HEP-641	SK 3011	RT-119	ECG 101
2N99	RS276-2001	GE-7	TR-08	PTC 108	HEP-641	SK 3011	RT-119	ECG 101

72 RADIO-ELECTRONICS • MARCH 1973

ARCH	G-E	IR	MAL	MOT	RCA	SPR	SYL	ARCH	G-E	IR	MAL	MOT	RCA	SPR	SYL
2N100	RS276-2001	GE-7	TR-08	PTC 108	HEP-641	SK 3011	RT-119	2N164	RS276-2002	GE-7	TR-08	PTC 108	HEP-641	SK 3011	RT-119
2N101	NA	NA	IRTR-84	NA	NA	NA	NA	2N165	RS276-2002	GE-7	TR-08	PTC 108	HEP-641	SK 3011	RT-119
2N103	RS276-2001	GE-7	TR-08	PTC 108	HEP-641	SK 3011	RT-119	2N166	RS276-2002	GE-7	TR-08	PTC 108	HEP-641	SK 3011	RT-119
2N104	RS276-2004	GE-2	IRTR-85	PTC 109	HEP-253	SK 3004	RT-121	2N167	RS276-2002	GE-6	TR-08	PTC 108	HEP-641	SK 3011	RT-119
2N105	RS276-2004	GE-2	IRTR-85	PTC 107	HEP-253	SK 3004	RT-121	2N168	RS276-2002	GE-7	TR-08	PTC 108	HEP-641	SK 3011	RT-119
2N106	RS276-2004	GE-2	IRTR-85	PTC 107	HEP-253	SK 3003	RT-121	2N169	RS276-2002	GE-7	TR-08	PTC 108	HEP-641	SK 3011	RT-119
2N107	RS276-2004	GE-2	IRTR-85	PTC 107	HEP-254	SK 3003	RT-120	2N170	RS276-2002	GE-5	TR-08	PTC 108	HEP-641	SK 3011	RT-119
2N108	RS276-2005	GE-2	IRTR-85	PTC 107	HEP-254	SK 3003	RT-120	2N171	NA	GE-7	TR-08	PTC 108	NA	NA	NA
2N109	RS276-2003	GE-2	IRTR-85	PTC 109	HEP-632	SK 3004	RT-121	2N172	RS276-2002	GE-7	TR-08	PTC 108	HEP-641	SK 3011	RT-119
2N111	RS276-2007	GE-1	IRTR-85	PTC 107	HEP-631	SK 3005	RT-118	2N173	NA	GE-4	TR-03	PTC 106	HEP-233	SK 3012	NA
2N112	RS276-2005	GE-1	IRTR-85	PTC 107	HEP-638	SK 3005	RT-118	2N174	NA	GE-4	TR-03	PTC 106	HEP-233	SK 3012	NA
2N113	RS276-2005	GE-1	IRTR-85	PTC 107	HEP-638	SK 3004	RT-118	2N175	RS276-2005	GE-2	IRTR-85	PTC 107	HEP-254	SK 3003	RT-121
2N114	NA	GE-1	IRTR-85	PTC 107	HEP-2	SK 3005	RT-118	2N176	RS276-2006	GE-3	TR-01	PTC 114	HEP-623	SK 3009	RT-124
2N115	NA	NA	TR-01	NA	NA	NA	NA	2N177	RS276-2006	GE-3	TR-01	PTC 122	HEP-230/232	SK 3009	RT-124
2N117	RS276-2009	GE-20	TR-21	PTC 132	HEP-53	SK 3020	RT-100	2N178	RS276-2006	GE-3	TR-01	PTC 114	HEP-230	SK 3009	RT-124
2N118	RS276-2009	GE-20	TR-21	PTC 132	HEP-53	SK 3020	RT-100	2N179	RS276-2005	GE-2	IRTR-85	PTC 109	HEP-254	SK 3004	RT-121
2N119	RS276-2009	GE-20	TR-21	PTC 132	HEP-53	SK 3020	RT-100	2N180	RS276-2005	GE-2	IRTR-85	PTC 135	HEP-254	SK 3004	RT-121
2N120	RS276-2009	GE-61	TR-21	PTC 121	HEP-53	SK 3020	RT-100	2N181	RS276-2005	GE-2	IRTR-85	PTC 108	HEP-641	SK 3011	RT-119
2N122	NA	NA	TR-23	NA	NA	NA	NA	2N182	RS276-2001	GE-7	TR-08	PTC 108	HEP-641	SK 3011	RT-119
2N123	NA	GE-1	IRTR-85	PTC 109	HEP-2	SK 3005	RT-118	2N183	RS276-2001	GE-6	TR-08	PTC 108	HEP-641	SK 3011	RT-119
2N124	RS276-2002	GE-7	TR-08	PTC 108	HEP-641	SK 3011	RT-119	2N184	RS276-2003	GE-2	IRTR-85	PTC 109	HEP-632	SK 3003	RT-121
2N125	RS276-2002	GE-7	TR-08	PTC 108	HEP-631	SK 3011	RT-119	2N185	RS276-2003	GE-2	IRTR-85	PTC 109	HEP-632	SK 3003	RT-121
2N126	RS276-2002	GE-7	TR-08	PTC 108	HEP-641	SK 3011	RT-122	2N186	RS276-2007	GE-2	IRTR-85	PTC 109	HEP-631	SK 3004	RT-121
2N127	RS276-2002	GE-7	TR-08	PTC 108	HEP-641	SK 3011	RT-122	2N187	RS276-2007	GE-2	IRTR-85	PTC 109	HEP-631	SK 3004	RT-121
2N128	RS276-2003	GE-9	IRTR-85	PTC 107	HEP-641	SK 3004	RT-119	2N188	RS276-2003	GE-2	IRTR-85	PTC 109	HEP-632	SK 3004	RT-120
2N129	RS276-2003	GE-9	IRTR-88	PTC 107	HEP-3	SK 3008	NA	2N189	RS276-2005	GE-2	IRTR-85	PTC 102	HEP-631	SK 3004	RT-120
2N130	RS276-2007	GE-2	IRTR-85	PTC 107	HEP-631	SK 3008	NA	2N190	RS276-2004	GE-2	IRTR-85	PTC 107	HEP-253	SK 3004	RT-120
2N131	RS276-2007	GE-2	IRTR-85	PTC 107	HEP-631	SK 3003	RT-120	2N191	RS276-2003	GE-2	IRTR-85	PTC 135	HEP-632	SK 3004	RT-120
2N132	RS276-2007	GE-2	IRTR-85	PTC 107	HEP-631	SK 3003	RT-120	2N192	RS276-2002	GE-2	IRTR-85	PTC 107	HEP-632	SK 3004	RT-120
2N133	RS276-2007	GE-2	IRTR-85	PTC 107	HEP-631	SK 3003	RT-120	2N193	RS276-2002	GE-5	TR-08	PTC 108	HEP-641	SK 3011	RT-122
2N134	NA	NA	IRTR-85	NA	HEP-631	NA	NA	2N194	RS276-2002	GE-5	TR-08	PTC 108	HEP-641	SK 3011	RT-122
2N135	RS276-2007	GE-1	IRTR-85	PTC 107	HEP-631	SK 3005	RT-118	2N195	RS276-2005	GE-2	IRTR-85	PTC 135	HEP-254	SK 3004	RT-120
2N136	RS276-2007	GE-1	IRTR-85	PTC 107	HEP-631	SK 3005	RT-118	2N196	RS276-2004	GE-2	IRTR-85	PTC 107	HEP-253	SK 3004	RT-120
2N137	RS276-2007	GE-2	IRTR-85	PTC 107	HEP-631	SK 3005	RT-118	2N197	RS276-2004	GE-2	IRTR-85	PTC 107	HEP-253	SK 3004	RT-120
2N138	RS276-2007	GE-2	IRTR-85	PTC 107	HEP-631	SK 3003	RT-121	2N198	RS276-2004	GE-2	IRTR-85	PTC 107	HEP-253	SK 3004	RT-120
2N139	RS276-2003	GE-1	IRTR-85	PTC 107	HEP-3	SK 3003	RT-121	2N199	RS276-2004	GE-2	IRTR-85	PTC 107	HEP-253	SK 3004	RT-120
2N140	RS276-2003	GE-1	IRTR-85	PTC 107	HEP-635	SK 3005	NA	2N200	RS276-2004	GE-2	IRTR-85	PTC 109	HEP-253	SK 3004	RT-120
2N141	NA	NA	TR-01	NA	NA	NA	NA	2N201	RS276-2001	GE-2	IRTR-85	PTC 109	HEP-641	SK 3004	RT-120
2N143	NA	NA	TR-01	NA	NA	NA	NA	2N202	RS276-2001	GE-2	IRTR-85	PTC 109	HEP-641	SK 3004	RT-120
2N145	RS276-2001	GE-7	TR-08	PTC 108	HEP-641	SK 3011	RT-119	2N206	RS276-2005	GE-2	IRTR-85	PTC 109	HEP-254	SK 3004	RT-120
2N146	RS276-2001	GE-7	TR-08	PTC 108	HEP-641	SK 3011	RT-119	2N207	RS276-2003	GE-2	IRTR-85	PTC 107	HEP-632	SK 3003	RT-120
2N147	RS276-2001	GE-10	TR-08	PTC 108	HEP-641	SK 3011	RT-119	2N211	RS276-2002	GE-5	TR-08	PTC 108	HEP-641	SK 3011	RT-122
2N148	RS276-2001	GE-7	TR-21	PTC 108	HEP-641	SK 3020	RT-119	2N212	RS276-2002	GE-5	TR-08	PTC 108	HEP-641	SK 3011	RT-122
2N149	RS276-2001	GE-7	TR-08	PTC 108	HEP-641	SK 3020	RT-122	2N213	RS276-2002	GE-8	TR-08	PTC 134	HEP-641	SK 3010	RT-122
2N150	RS276-2001	GE-7	TR-08	PTC 108	HEP-641	SK 3020	RT-122	2N214	RS276-2002	GE-8	TR-08	PTC 134	HEP-641	SK 3010	RT-122
2N151	RS276-2005	GE-2	IRTR-85	PTC 102	HEP-254	SK 3011	RT-119	2N215	RS276-2005	GE-2	IRTR-85	PTC 109	HEP-254	SK 3004	RT-121
2N155	RS276-2006	GE-3	TR-01	PTC 114	HEP-230	SK 3009	RT-120	2N218	RS276-2002	GE-5	TR-08	PTC 108	HEP-641	SK 3011	RT-122
2N156	RS276-2006	GE-3	TR-01	PTC 105	HEP-230	SK 3009	RT-120	2N217	RS276-2005	GE-2	IRTR-85	PTC 109	HEP-636	SK 3004	RT-121
2N157	RS276-2006	GE-3	TR-01	PTC 122	HEP-230/232	SK 3009	RT-124	2N219	RS276-2003	GE-1	IRTR-89	PTC 107	HEP-3	SK 3005	NA
2N158	NA	GE-3	TR-01	PTC 105	NA	SK 3009	RT-127	2N220	RS276-2005	GE-2	IRTR-85	PTC 107	HEP-254	SK 3005	NA
2N159	NA	GE-52	IRTR-85	PTC 102	NA	SK 3004	RT-20	2N221	NA	NA	NA	NA	NA	SK 3004	RT-121
2N161	RS276-2009	GE-20	TR-21	PTC 132	HEP-53	SK 3020	RT-100	2N222	RS276-2004	GE-2	IRTR-85	PTC 107	HEP-253	SK 3004	RT-121
2N162	RS276-2009	GE-20	TR-21	PTC 132	HEP-53	SK 3020	RT-100	2N223	RS276-2005	GE-2	IRTR-85	PTC 135	HEP-254	SK 3003	ECG 102A
2N163	RS276-2009	GE-20	TR-21	PTC 132	HEP-53	SK 3039	RT-108	2N224	RS276-2005	GE-2	IRTR-85	PTC 135	HEP-254	SK 3004	RT-121
						SK 3020	RT-100	2N225	RS276-2005	GE-2	IRTR-85	PTC 135	HEP-254	SK 3004	RT-121

(continued next month)



PROGRAM  
GUIDE

# THE SIZZLING 66

RAYTHEON

**Now  
appearing  
at your local  
distributor's.**

Here it is! A sure fire guide to a profit loaded market. The foreign-made TV, stereo, AM/FM radio, tape deck and cassette player service market. And this time saving guide is yours FREE.

The program is Raytheon's Sizzling 66. A collection of top quality semiconductors designed to replace over 5000 foreign devices.

And our guide to this program will be your guide. It cross-references the thousands of foreign semiconductors to the exact Raytheon

replaceable. Complete with all electrical, mechanical and terminal arrangement data. So you can find the information you need—fast. Without frustration and confusion.

A beautiful program, a beautiful program guide (and it fits right in your service caddy). For all the details see your local Raytheon distributor. Or contact Raytheon Company, Distributor Products Operation, Fourth Avenue, Burlington, Mass. 01803. Telephone 617-272-6400.

RAYTHEON





## ADVANCED ELECTRONICS CAREER TRAINING AT HOME

Modern aircraft are loaded with vital electronic equipment. There is equipment for communications, direction finding, instrument landing and for many other functions to insure safe operation of the aircraft.

The man who checks out this equipment has to be an expert. Many lives depend on his specialized knowledge as an engineering technician. His work is interesting and exciting and he enjoys top pay in his field.

# Consider a career In advanced electronics

Aeronautical and Navigational Electronics is just *one* of the advanced electronics programs CREI offers. There are *seventeen* others. All of the programs, except a brief introductory course, are college-level. The programs cover every major field of electronics today.

If you want to qualify for the highest paying level of technical employment in electronics, we invite you to consider the unique home study programs of CREI. Here is a list of just some of the CREI programs: *Communications Engineering • Computer Engineering • Missile & Spacecraft Guidance • Radar & Sonar • Television Engineering • Nuclear Instrumentation & Control • Digital Communications • Industrial Electronics • Electronic Systems Engineering • Microwave Communications • Satellite Communications • Cable Television Engineering*

For over 45 years, CREI programs have been recognized by industry and government as effective home study training in advanced electronics.

**Qualifications to enroll.** To qualify for enrollment in a CREI program, you must be a high school graduate (or equivalent). You should also be working in electronics or have previous training in this field.

**Send for FREE book.** If you are qualified, send for CREI's newly published book describing your career opportunities in advanced electronics. This full color book is filled with facts about career opportunities for you.

**Capitol Radio Engineering Institute**  
A Division of McGraw-Hill Continuing Education Co.  
3939 Wisconsin Avenue, Washington, D. C. 20016



Accredited Member, National Home Study Council

CREI, Dept. E1403D  
3939 Wisconsin Avenue  
Washington, D.C. 20016

Rush me your FREE book describing my opportunities in advanced electronics. I am a high school graduate.

Name \_\_\_\_\_ Age \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ ZIP \_\_\_\_\_

If you have previous training in electronics, check here

Employed by \_\_\_\_\_

Type of Present Work \_\_\_\_\_

Veterans and servicemen, check here for G. I. Bill information

**CREI**  
**CAPITOL  
RADIO  
ENGINEERING  
INSTITUTE**  
WASHINGTON, D.C.

# HOW DOES GEORGE DO IT?

#1 IN A SERIES



IN EVERY GROUP OF TECHNICIANS THERE'S A "GEORGE" WHO ALWAYS SEEMS TO EARN A LITTLE MORE THAN THE REST OF US - SOMETIMES EVEN WITH SHORTER HOURS. TO HELP EVERY TECHNICIAN MAKE THE MOST OF HIS TIME, HERE'S "HOW GEORGE DOES IT":



## READER QUESTIONS

(continued from page 70)

same time. You are obviously getting B + (+350 V) on the screens, through some kind of shunt path. This is too low voltage for the screens, and the pix tube is simply cut off.

Replace the B++ rectifier (RCA SK-3109) and the 68K resistor (use a 2-watt for luck) and I think you'll get results. If your *boost* voltage is normal, and B++ isn't, there are only two parts left!

### ACC PROBLEM

I've got a fair picture on this Admiral 2H5 transistor TV chassis, but I get no snow at all with the antenna off. Weak-signal response very bad, and this set works on an antenna in a low signal area. My age controls don't respond as they should. Where should I start?—R.G. Aurora, Colo.

Run a step-by-step check on the action of the whole age circuit. Start by verifying the keying pulse and video signals on the i.f. age keyer. Check the dc voltages on base and emitter; then take the antenna off and see if they change; they should!

This is a three-stage age circuit; i.f. age keyer, rf age, and an rf age delay transistor. The dc voltages on all

# DISCOUNT PRICES TEST EQUIPMENT



Catalog & Prices on Request

**FORDHAM** Radio Supply Company, Inc.

558 Morris Ave. Bronx, N.Y. Tel: (212) 585-0330 **RCA**

DISTRIBUTORS OF ELECTRONIC SUPPLIES

Circle 23 on reader service card

of these should change when the signal is taken off or put on. If you find one that doesn't, there you are. (Watch out for bad solder joints! I found one of these with the same symptoms, and the emitter lead of the i.f. agc transistor was loose.)

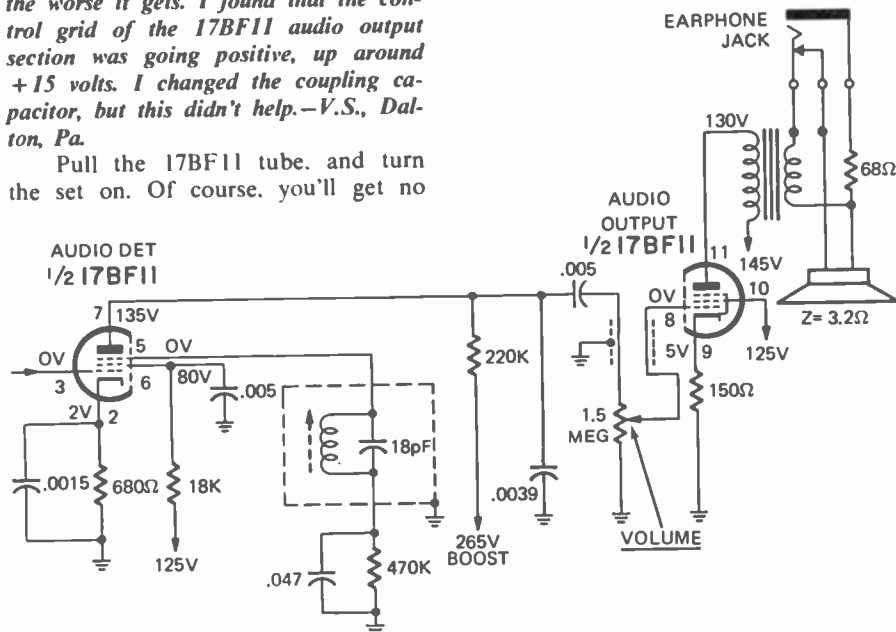
#### BAD SOUND

*I've got a GE portable, with a funny sound problem. The longer it's on, the worse it gets. I found that the control grid of the 17BF11 audio output section was going positive, up around +15 volts. I changed the coupling capacitor, but this didn't help.—V.S., Dalton, Pa.*

Pull the 17BF11 tube. and turn the set on. Of course, you'll get no

raster since the heater string will be open. However, you'll have B+ on the plate (pin-7) of the audio detector. Take a reading at the grid terminal of the output section, pin 8. This should read zero. If there's any leakage across the socket, etc., it will show up here.

If this test shows no leakage, replace the 17BF11 tube. The chances are that it has developed internal leakage, like the old 50B5's, etc used to.



## Profits grow faster with SK 3016.

It's all you need to put top-of-the-line quality in nearly 2,600 replacements. With it, you can offer more on-the-spot service and build better business efficiency all down the line. It's just one of RCA's 156 SK devices that can replace over 51,000 different foreign and domestic types.

See your RCA Distributor today. He'll give you the full story on SKs and your copy of the new RCA SK Replacement Guide SPG-202N. RCA Electronic Components Harrison, N.J. 07029

**RCA** Electronic Components



## Now...the most enjoyable do-it-yourself project of your life—a Schober Electronic Organ!

You'll never reap greater reward, more fun and proud accomplishment, more benefit for the whole family, than by assembling your own Schober Electronic Organ.

You need no knowledge of electronics, woodwork or music. Schober's complete kits and crystal-clear instructions show you—whatever you are, whatever your skill (or lack of it)—how to turn the hundreds of quality parts into one of the world's most beautiful, most musical organs, worth up to twice the cost of the kit.



Circle 24 on reader service card

Five superb models with kit prices from \$500 to around \$2,000, each an authentic musical instrument actually superior to most you see in stores, easy for any musically minded adult to learn to play, yet completely satisfying for the accomplished professional. And there are accessories you can add any time after your organ is finished—lifelike big auditorium reverberation, automatic rhythm, presets, chimes, and more.

Join the thousands of Schober Organ builder-owners who live in every state of the Union. Often starting without technical or music skills, they have the time of their lives—first assembling, then learning to play the modern King of Instruments through our superlative instructions and playing courses.

Get the full story FREE by mailing the coupon TODAY for the big Schober color catalog, with all the fascinating details!

The Schober Organ Corp., Dept. RE-112  
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 \_\_\_\_\_



The grid slowly went more positive, and the sound went bad, just as you say.

### AM GOOD, FM DEAD

*The AM works fine on this Zenith 9ZT15 radio, but I can't get anything on FM. It's completely dead. Where would you look for this?—E.B., Adams, Mass.*

If you can get an AM signal through, the first two i.f. transistors and i.f. transformers are OK. They work on both AM and FM. However, there is a 3rd i.f. transistor which is used only on FM. Check this one. It's probably open or shorted. For a defi-

nite check, feed a 10.7 MHz AM signal into the i.f. input. If this won't go through, that's it.

If it does, the trouble is in the FM oscillator or rf transistor, or the FM tuner; loose solder joint, coil, etc.

### BLUE BOWING OF HORIZONTAL LINES

*I've replaced the flyback in a Magnavox T-931 color chassis. Now, everything else is OK, but I have a severe bowing of the blue horizontal lines. Can't converge them at all. I've tried everything I can think of.—G.O. Towner, N.D.*

Go back through the convergence

circuitry and check the pulses from the flyback. Be sure that they are of the right amplitude and polarity! I have a suspicion that you'll find some leads reversed somewhere, causing a pulse of the wrong polarity to be fed to the blue circuitry. This would throw the blue out of convergence instead of pulling it in. Diode X8 will probably get warm, too. (Field feedback from reader confirmed this. The leads to terminals 1 and 2 on the replacement flyback were reversed. Swapping these cured the trouble.

### THERMAL RUNAWAY

*I've got a Coronado RA60 radio on the bench. It's dead, output transistors very hot. Replaced them with RCA SK-3004 and it worked. After about an hour—the transistors got hot and it went dead. I cooled them off, and it started up, and ran for another hour. Voltages look OK.—S.G. Lakewood, Ohio*

You seem to be getting a fine example of thermal runaway. This is probably due to insufficient heat-sinking of the output transistors. I've had the same trouble. With the SK-3004 transistors, you can make a "clamp" type heat-sink and tie them to the chassis, on the biggest piece of solid metal. This ought to keep them cool enough.

Don't try this with transistors that

# CHANNELLOCK

Gives You More In Hand Tools Including

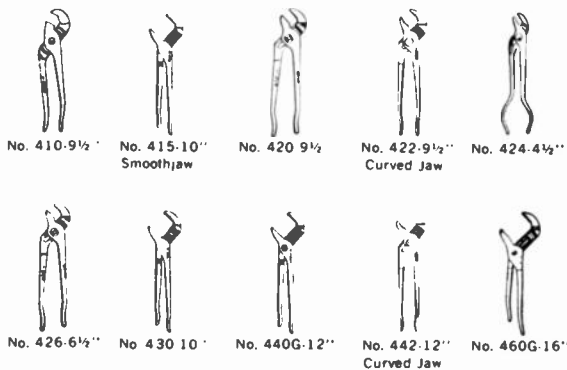
## WRAP AROUND BITE

(PLUS tongue-'n-groove muscle)

Another CHANNELLOCK first: curved jaws that wrap around and grab hold of round work plus CHANNELLOCK's exclusive machined, smooth working, undercut, never-slip adjustments. The "muscle" of a wrench, the easy handling of a plier in hard-to-reach spots . . . yours with CHANNELLOCK Curved Jaw tongue-'n-groove pliers.

GET THE WHOLE STORY. Our catalog is yours for the asking.

### MEET THE FAMILY



TOOLS BY  
**CHAN NEL LOCK**

MEADVILLE, PA. 16335



## ELECTRONIC TECHNICIANS!

Raise your professional standing and prepare for promotion! Win your diploma in

### ENGINEERING MATHEMATICS

from the Indiana Home Study Institute

We are proud to announce two great new courses in Engineering Mathematics for the electronic industry.

These unusual courses are the result of many years of study and thought by the President of Indiana Home Study, who has personally lectured in the classroom to thousands of men, from all walks of life, on mathematics, and electrical and electronic engineering.

You will have to see the lessons to appreciate them!

NOW you can master engineering mathematics and actually enjoy doing it!

WE ARE THIS SURE: you sign no contracts—you order your lessons on a money-back guarantee.

In plain language, if you aren't satisfied you don't pay, and there are no strings attached.

Write today for more information and your outline of courses.

You have nothing to lose, and everything to gain!

The INDIANA HOME STUDY INSTITUTE

Dept. RE-3, P.O. Box 1189, Panama City, Fla. 32401





**SERVICEMASTER  
is  
your best buy  
in domestic  
and  
foreign  
tubes.**

- Discounted to provide you with a higher profit margin.
- Proven quality for better customer satisfaction.
- A complete range of domestic and foreign service types for consumer and industrial electronics.

For complete details, contact your International representative today, or International Components, 10 Daniel Street, Farmingdale, New York 11735/(516) 293-1500

**SERVICEMASTER  
International ©**  
International Components Corp.  
Div. of IESC

Circle 28 on reader service card

have their collectors connected to the case, unless you insulate the cases very well. Sheet mica, and silicone transistor-grease will help to raise the heat-transfer.

**NO FOCUS**

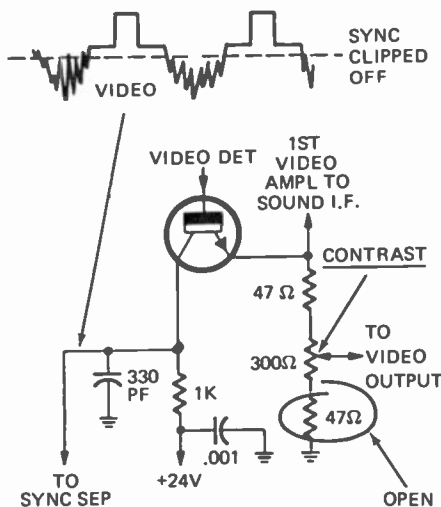
*I've got no focus voltage at all on a Zenith 25LC30. The focus-rectifier socket has burnt up. This is riveted to the flyback cage. Can I replace this with a solid-state focus rectifier?—R.M., Mena, Ark.*

You sure can. An RCA SK-3066 can be soldered in place inside the flyback cage, with little trouble. Connect the cathode to the 2.7-megohm resistor going to the focus control, and the anode to the grey wire from the flyback; this went to pin 9 of the 1V2 tube. Mount this on a small terminal strip soldered to the frame of the flyback. You can put a dab of high-voltage putty around the terminal for luck, if you want to.

**NO SYNC**

*In a Zenith 22ABS5 solid-state black and white TV, there is no sync at all. The picture can be stopped by very delicate adjustment of the holds. Video looks normal in amplitude. A scope shows the signal at the sync input with the sync clipped off like it had been shaved with a razor. Transistor good, by substitution. Collector voltage is high. R.Q., Ft. Smith, Ark.*

Check your contrast control. If it has no effect at all, the circuit is prob-



ably open. This upsets the loading on the emitter, and lets the transistor clip the sync, though the video goes through. I found the same thing in one of these, with a weird cause; the lower 47-ohm resistor was open, and it looked as if the wire lead to the resistor had *fatigued* and broken. Of course, I thought someone had accidentally clipped it, but examination with a glass showed it wasn't. This upsets video to both sync and agc. R-E

**You'll win new  
customers  
with  
SK 3122.**

Because it's the fast, easy way to put premium performance in over 2,800 different sockets. And that's the best way to give better service and get more customers.

Try it and see. Contact your RCA Distributor today. Ask him, too, for the new RCA SK Replacement Guide SPG-202N. It cross-references the entire SK line of 156 devices to replace over 51,000 foreign and domestic types.

RCA Electronic Components  
Harrison, N.J. 07029

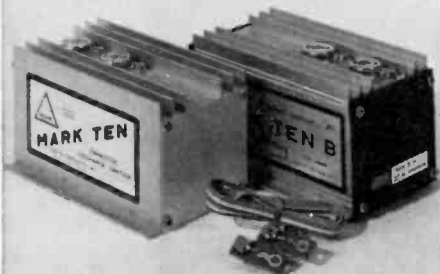
**RCA** Electronic Components



Circle 29 on reader service card  
MARCH 1973 • RADIO-ELECTRONICS 81

# Reduce Car Maintenance Increase Engine Performance.

Put a Mark Ten Capacitive Discharge Ignition (CDI) System On Your Car.



Even Detroit finally recognizes that electronic ignition systems dramatically increase engine performance. Chrysler is now putting them on their new models. The Mark Ten CDI, the original electronic ignition system, has been giving increased performance with lower maintenance to hundreds of thousands of satisfied customers for over eight years. Install a Mark Ten CDI on your car, boat or truck and eliminate 3 out of 4 tune-ups. Increase gasoline mileage up to 20%. Enjoy improved engine performance. Or put a Mark Ten B on your car. It was especially designed for engines with smog control devices. By reducing combustion contaminants, the Mark Ten B restores power losses caused by these devices. Equipped with a convenient switch for instant return to standard ignition, the Mark Ten B is applicable to ANY 12 volt negative ground engine. Both systems install in 10 minutes with no rewiring. Order a Mark Ten or Mark Ten B CDI today.

Mark Ten (Assembled) \$44.95 ppd.  
 Mark Ten (DeltaKit) \$29.95 ppd.  
 (Kit available in 12 volt only, positive or negative ground.)  
 Mark Ten B \$59.95 ppd.  
 (12 volt negative ground only)

Superior Products at Sensible Prices  
 Mfg. in U.S.A.

 **DELTA PRODUCTS, INC.** Dept. RE

P.O. Box 1147 / Grand Junction, Colo. 81501  
 (303) 242-9000

Please send me free literature.

Enclosed is \$ \_\_\_\_\_  Ship ppd.  Ship C.O.D.

Please send:

\_\_\_ Mark Ten B @ \$59.95 ppd.

\_\_\_ Standard Mark Ten (Assembled) @ \$44.95 ppd.

\_\_\_ 6 Volt: Neg. Ground Only

\_\_\_ 12 Volt: Specify

\_\_\_ Positive Ground \_\_\_ Negative Ground

\_\_\_ Standard Mark Ten (DeltaKit®) @ \$29.95 ppd.

(12 Volt Positive Or Negative Ground Only)

Car Year \_\_\_\_\_ Make \_\_\_\_\_

Name \_\_\_\_\_

Address \_\_\_\_\_

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

Circle 61 on reader service card

# new products

More information on new products is available from the manufacturers of items identified by a Reader Service number. Use the Reader Service Card inside the back cover.

**8-TRACK STEREO RECORDER-PLAYER, Model 8055**, has preamplified deck with a counter that displays elapsed time in minutes and seconds.

Cartridge unit is capable of moving the tape at 2-½ times actual speed in the fast-forward mode. Cueing system assures that the tape is always at the beginning when recording. Automatic eject



prevents accidental erasure of previously recorded material.

Other features include a pause lock, illuminated dual VU meters and a switchable automatic record level control. Signal to noise ratio is better than 50 dB and frequency response is 40 to 15,000 Hz. \$159.95.—3M Company, P.O. Box 33600, St. Paul, Minn. 55133.

Circle 31 on reader service card

**AUTOMATIC TURNTABLE, Model 625**, features all-pushbutton operation; precision cueing for playing any desired band on a record during single-play operation; balanced tone-arm and a built-in stylus-force dial, accurate to within 0.1 gram, from 0 to 6.5 grams, and effective



antiskate; a balanced four-pole asynchronous motor, and a heavy pressure-formed turntable platter that reduce annoying wow and flutter.

Conventional 4-speed operation is offered and in automatic mode, the model will accommodate a stack of up to ten records, 7", 10" or 12". Regardless of the height of the stack, speed accuracy

is better than 1% from first to last record in the stack. Interchangeable insert for the tone-arm accepts all standard phono cartridges.—Benjamin Electronic Sound Corp., 40 Smith Street, Farmingdale, N.Y. 11735.

Circle 32 on reader service card

**4-CHANNEL DECODER KIT AD-2022.**

Unit decodes all matrix encoded records now on the market and also enhances recorded stereo material and stereo FM broadcasts by reproducing the out-of-phase ambience common to 2-channel programming. This hidden presence is fed to two rear speakers resulting in a 4-



channel effect.

All that's needed to convert a stereo system to 4-channel using this unit is an existing stereo amplifier with tape-monitor jacks, any additional stereo amplifier and two additional rear speakers.—Heath Company Benton Harbor, Mich. 49022.

Circle 100 on reader service card

**AUDIO CABLE, Model 44-359**, is 12-feet long with a 3-conductor cable, standard 3-way phone plug to standard 3-way in-line jack.

This model was designed for use as a



headphone and stereo speaker extension cable, for tape recorders, receivers or 8-track and cassette tape players. \$3.08.—**Weltron Company**, 305 S. Dillard Street, Durham, N.C. 27702.

Circle 33 on reader service card

**AUDIO FREQUENCY METER, Model 1200A**, incorporates the latest LSI in-



tegrated circuit chips and a 4-digit solid-state LED display.

Frequency can be read directly up to 1.999 MHz and indirectly to typically 3.5 MHz over three ranges. The lowest range extends the sample period to ten seconds and provides 0.1-Hz resolution necessary for calibrating electronic musical Instruments.

The high input impedance and sensitivity minimize loading and allow measurements in low-level circuitry. Despite the 20-mV sensitivity, the model can withstand a 200 Vac and 400 Vdc overload indefinitely. The monolithic input circuitry in conjunction with the threshold control eliminate false triggering from noise and high harmonic levels. The built-in hysteresis is proportional to the input signal level. \$245.00.—**Linear Digital Systems**, Box 954, Glenwood Springs, Colo. 81601.

Circle 34 on reader service card

**MUSICAL INSTRUMENT TUNER, Model 747**, tunes any electric, acoustic or bass 4- and 6-string guitars.

Electronic tuning-fork device provides a reference tone signal at the precise

## Keep inventories small with SK 3004.

It's the only solid-state device you need to make over 4,000 different replacements. And it's just one part of RCA's compact SK line of 156 devices that can replace over 51,000 foreign and domestic types. SK is the way to go to cut inventory to the bone and still have the replacement you need when you need it.

Ask your RCA Distributor about SK, The Solid State System. And get your copy of the new RCA SK Replacement Guide SPG-202N.

RCA Electronic Components  
Harrison, N.J. 07029

**RCA** Electronic Components



Circle 63 on reader service card

*The "Country Boys" Have it!*

### Make Your Own DRIVE BELTS & "O" RINGS



**PRODUCE INSTANT DRIVE BELTS & "O" RINGS**

Three Kits do it all! Your kits eliminate need for stocking large replacement inventory. This is all you need to make easy repairs on... 8 tracks, cassettes (both imports and domestic) whether drive belt is round, flat or square. Kits come complete with ample rubber stock, Instant-Weld Adhesive, jig for controlling cuts, razor blade and special cleaning compound.

- ORK-1 Round Rubber Drive Belt Kit
- ORK-2 Flat & Square Rubber Drive Belt Kit
- ORK-3 "O" Ring Kit

No "down time"... no specials... no molds... no vulcanizing. Order Your Kits NOW. Cash in on big profits.

Also... Buy Oneida's new, improved INSTANT-WELD High Strength-Rapid Bonding ADHESIVE. One drop can do the trick. Buy Instant-Weld Permanent Bond Adhesive at your dealer or distributor. Write for our complete catalog and discount prices.

**ONEIDA ELECTRONIC MFG. INC.**  
MEADVILLE, PA. 16335



George Dalton

ELECTRONIC MFG. CO.



Circle 62 on reader service card

# If what you don't know about converting stereo to 4-channel sound would fill a book... write for the book.

Quadraphonic. Quadrosonic. Matrix. Discrete. SQ. QS. EV-4. CD-4. Logic. Demodulator. Decoder. Ambience Recovery. Derived. Synthesized.

Confused? We can't blame you.

We can help you.

4-channel is great to listen to, but murder to talk about.

There's a new vocabulary to learn. And new kinds of components.

New ways to use old components. New places to put speakers. Complex wiring. And more.

BSR-Metrotec makes equipment to convert your stereo

system to 4-channel, at minimum cost, and without replacing any of your present components.

We think you'll like 4-channel. And if you'll spend a few minutes with our free booklet, you'll understand it, and be better able to decide if it's for you.

## BSR METROTEC

BSR (USA) Ltd., Blauvelt, N.Y. 10913

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

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



Circle 64 on reader service card

frequency of each string. When tuning the guitar, the operator can hear the accurate reference tone and the guitar string. There is also an audio indication



of tuning accuracy.

Accuracy of tuning is within 0.01% or approximately 1/4 Hz. \$129.95.—Electro-Tunes, Inc., 2116 N. Scottsdale Road, Scottsdale, Ariz. 85257.

Circle 35 on reader service card

DESOLDERING IRON, Model 510, offers three features—safety power indicating light, 3-way on-idle-off switch and bracket to insure alignment and prevent



## Why pay an answering service when you can own your own?



Dictaphone has a machine to make sure you never lose another cent through a missed phone call or a garbled message. In fact, we have a whole line of them.

They're called Ansafones. You can buy one outright or possibly lease it for about what you're paying your answering service now. And it works for you 24 hours a day, 7 days a week.

For a free brochure describing how much an Ansafone can help you, mail this coupon now.

▶ Dictaphone

Box A-3-34, 120 Old Post Road, Rye, New York 10580

Please send me full details of the Ansafone line.

Name \_\_\_\_\_

Company \_\_\_\_\_ Phone \_\_\_\_\_

Address \_\_\_\_\_

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

Ansafone and Dictaphone are registered trademarks of Dictaphone Corp.

Circle 65 on reader service card

## FREE catalog

over  
**1000**  
unique tools,  
handy kits,  
precision  
instruments,  
technical  
supplies.



Our 20<sup>th</sup> year of service to the World's finest craftsmen and technicians.



**National Camera**  
2000 West Union Ave. Dept. G88  
Englewood, Colorado, 80110

Send a FREE copy of the nc Flasher

name \_\_\_\_\_

address \_\_\_\_\_

city \_\_\_\_\_

state \_\_\_\_\_

zip \_\_\_\_\_



**National Camera**  
2000 West Union Ave. Dept. G88  
Englewood, Colorado, 80110

Circle 66 on reader service card

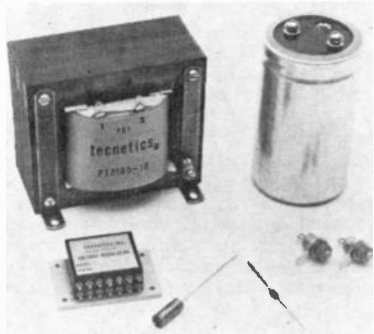
damage.

It operates at 40W and idles at 20W for longer tip life. Located inside the handle, the light indicates operation at both heats with different intensity for each.

Other features include six tip sizes for every job, cool, unbreakable poly-carbonate handle and flexible, burn resistant neoprene cord. 8½" long, 3½ oz. \$16.00.—Enterprise Development Corp., 5127 East 65th Street, Indianapolis, Ind. 46220.

Circle 36 on reader service card

**POWER SUPPLY KITS.** Unregulated kits range from 5 to 48 Vdc at 1, 5 and 10 amps. Regulated kits range from 5 to ±15 Vdc at 2, 5 and 10 amps with



0.15% line and 0.2% load regulation. Highly regulated kits range from 5 to ±18 Vdc at 0.25, 0.5, 1, 5 and 10 amps

with 0.01% + 1mV load regulation. Prices start at \$13.—Tecnetics Inc., Boulder Industrial Park, Boulder, Colo. 80302.

Circle 37 on reader service card

**COLOR BAR GENERATOR, WR-508B.** provides test signals to adjust convergence, color-phasing, purity and linearity of color TV receivers. AC or battery operation. Crystal-controlled solid-state circuitry provides stable patterns with no flicker. Three pattern adjustment controls on the rear panel.

Ten color bars are provided simultaneously in the color bar pattern spaced at 30-degree intervals. This pattern is used to check color phase and matrix circuits and adjust the automatic fre-



quency phase control. Narrow brightness pulses are added to the edges of color bar to aid in checking the color fit or registration of the brightness and color signals. \$85.00.—RCA, Electronic Components, Harrison, N.J. 07029. R-E

Circle 38 on reader service card

## The New AR-7

### Designed for accurate reproduction of four channel sound

Four channel installations present a particular problem when it comes to speaker placement. To get maximum listening pleasure, all four speakers have to be placed properly. This can create a considerable space problem. The AR-7 is designed to meet that problem. Four AR-7's take up less space than one AR-3a, and yet each produces sound of such accuracy that you need not compromise on the sound of your four channel system.

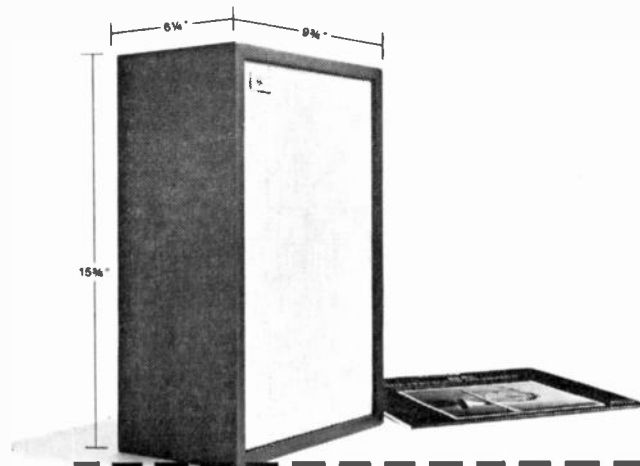
The AR-7 utilizes a newly designed 8" woofer capable of handling considerable power and

having low bass response not formerly associated with speakers of such small size. The tweeter is essentially identical to that of the highly acclaimed AR-6; very smooth, with extremely wide dispersion.

While the size of the AR-7 makes it a suitable choice for four channel installations, the sound is of such accuracy that it is a logical choice for a stereo system.

Size: 9¾" x 15¾" x 6¼" deep.

AR-7's come packed two to a box, and sell for less than any other AR speaker; \$60.00 each.



Acoustic Research, Inc.  
24 Thorndike St.  
Cambridge, Mass. 02141

Please send more information on the new AR-7

Name .....

Street .....

City .....

State ..... Zip .....

Circle 68 on reader service card



**THOUSANDS OF BARGAINS—TOP VALUES IN Electronic Parts**

Transistors, Modules, Speakers, Stereo, Hi-Fi, Photo Cells and thousands of other Electronic Parts. Send for **FREE** Catalog




**ELECTRONIC DISTRIBUTORS INC.**  
Dept. TA-2, 4900 Elston  
Chicago, Ill. 60630

RUSH CATALOG

Name \_\_\_\_\_

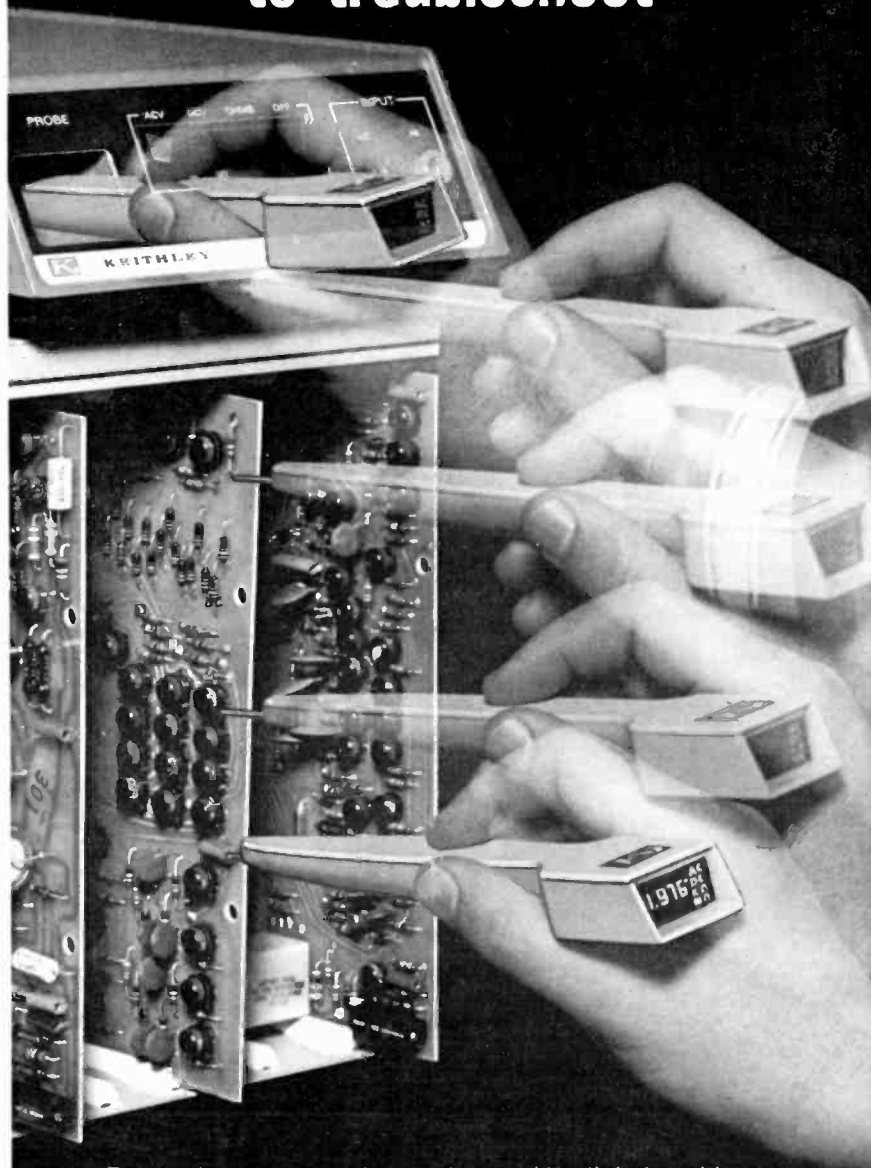
Address \_\_\_\_\_

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

Circle 67 on reader service card



# The fast and easy way to troubleshoot



This unique, automatic ranging, ac/dc digital multimeter puts the data right at your fingertips.

The Model 167 Auto-Probe DMM:

- measures dc voltage - 1 mV to 1000 volts
- measures ac voltage - 1 mV to 500 volts rms
- measures resistance - 1 ohm to 20 megohms
- measures current - with optional shunts
- battery operated (line adapter optional)

It's fast (saves time!), it's accurate, and its readout is right in the hand-held probe.

The Model 167 Auto-Probe DMM — only \$325. Send for more details.

**KEITHLEY INSTRUMENTS**  
 U.S.A. 28775 AURORA ROAD, CLEVELAND, OHIO 44139  
 EUROPE: 14, AVENUE VILLARDIN, 1009 PULLY, SUISSE

Circle 69 on reader service card

# new lit

All booklets, catalogs, charts, data sheets and other literature listed here with a Reader Service number are free. Use the Reader Service Card inside the back cover.

**CARTRIDGE STYLUS GUIDEBOOK**, "A Visit To The Small World Of A Stylus." The stylus in a hi-fi stereo cartridge is the source of sound for any high fidelity stereo system. The catalog tells about the function, care and replacement of this vital component.

The stylus is actually a miniaturized electromagnetic converter that must carry the full burden of translating ultracomplex stereo record grooves into usable electric impulses without adding or subtracting from what is on the recording.—Shure Brothers, Inc. 222 Hartrey Avenue, Evanston, Ill. 60204.

Circle 39 on reader service card

**REPLACEMENT PHONO CARTRIDGE CATALOG**, No. 72C designed for quick access to all the information a technician requires.

## TUNE-IN

on these TOP-RATED "NO-NOISE" PRODUCTS

PROVEN PERFORMANCE FOR COLOR AND B/W

**FIRST**, simply spray parts with **SUPER SPRAY BATH**. Dissolve and flush away grease, dirt, oil and oxidation—penetrative action cleans and restores all component parts.

**THEN**, follow with **VOLUME CONTROL AND CONTACT RESTORER**

for special attention to volume controls, push button assemblies, band switches, relays and other electrical contacts.

"NO-NOISE" products are guaranteed non-flammable, no carbon tet, non-toxic—safe for plastics.

For Tuners (Incl. wafer type) use **TUNER TONIC** With Perma Film OR **SUPER LUBE** for further

cleaning and lubrication—economical, a little does a lot.

Other Famous "NO-NOISE" Products  
 • EC-44 • Frigid Air • Tape-Race Head Cleaner



Often imitated but never duplicated

**ELECTRONIC CHEMICAL CORP.**  
 813 Communipaw Avenue Jersey City, N. J. 07304

Circle 70 on reader service card

Sections include alphanumeric index, numerical listing of Electro-Voice Cartridges, alphabetical listing of cartridges by brand names and listing of set manufacturers' model numbers cross-referenced to Electro-Voice Cartridge replacement. Also included is full line of replacement record changer and phono motors, centerposts, tone arms and 45-rpm adaptors for record changer use. Complete line of stereo headphones and audio accessories is also listed.—E-V/Game, Inc., 80 Commercial St., P.O. Box 711, Freeport, N.Y. 11520.

Circle 40 on reader service card

**TEST JIG ACCESSORIES.** 12-page brochure illustrates the various cables and adapters used with RCA Industry Compatible Test Jig. Color TV sets of 41 manufacturers can be serviced with an RCA Color TV Test Jig.

Pictured in the brochure are extension cables and Universal adapters, all identified by their appropriate stock numbers. Deflection yoke adapters, convergence adapters and automatic degaussing adapters are also listed.

The brochure has a cross-reference chart listing all cables included in the program by description, numerical order.—RCA Parts and Accessories, 2000 Clements Bridge Rd., Deptford, N.J. 08096. R-E

Circle 41 on reader service card



\*Controlled Quality Crystals for "ON CHANNEL" Communications

FOR  
**CITIZEN BAND**  
23 Channels and "Mars"  
**HAM OPERATORS**  
Commercial 2-Way  
**Marine-Monitor**  
See your Distributor for Speedy  
"Zip Certificates"



formerly Texas Crystals  
Div. of Whitehall Electronics Corp.  
1000 Crystal Drive 4117 W Jefferson Blvd  
Fort Myers, Florida 33901 Los Angeles, California 90016  
Circle 71 on reader service card



Telex headphones and headsets give you that comfortable feeling of assurance when you monitor broadcasts or communications. Signals come through loud and clear — intelligibly and reliably.

Telex professional monaural or stereo headphones incorporate audiometric-type transducers that are impervious to temperature or humidity changes and provide you with absolute performance consistency day in, day out. These sensitive dynamic transducers produce high output levels with minimum consumption of transmission power. Available in single or dual muff configuration and with noise cancelling dynamic or carbon boom microphones.

You'll never miss a cue or program buss with a Telex Announcers Earset®. Inconspicuous for 'on camera' work, it has practically become standard in the industry. And the Sportscaster headset, with a dynamic, broadcast quality, boom microphone assures precise voice transmission for live, remote broadcasts.

Or you can select a Teleset®, Twinset® or Earset® for lightweight, comfortable and inexpensive private monitoring. And for special applications in business or home, industry or institution, Telex makes a listening device to fit your requirements. Available at better sound dealers or write for free information.

PRODUCTS OF SOUND RESEARCH

**TELEX®**

COMMUNICATIONS DIVISION

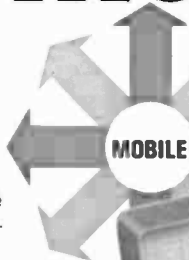
9600 ALDRICH AVENUE SOUTH  
MINNEAPOLIS, MINNESOTA 55420



CANADA: DOUBLE DIAMOND ELECTRONICS, LTD., Ontario  
EUROPE: ROYAL SOUND COMPANY, INC., 409 North Main Street, Freeport, N.Y. 11520 U.S.A.  
INTERNATIONAL: TELEX EXPORT DEPT., 9600 Aldrich Ave. So., Minneapolis, Minn. 55420 U.S.A.

Circle 72 on reader service card

# INTERNATIONAL Frequency meter FM-2400CH



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.

**WRITE FOR CATALOG!**



- 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

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 MFG. CO., INC.  
10 NO. LEE • OKLA. CITY, OKLA. 73102

Circle 73 on reader service card

## Judge for Yourself!

Compare specifications...in the receiver...in the transmitter of our FM-2101 series



FCC Type Accepted Parts 15, 21, 89, 91, 93

**25 WATT ALL SOLID STATE VHF-FM BUSINESS RADIO**

Sonar's latest receiver design uses a Dual-Gate Field Effect Transistor, a Dual Monolithic Crystal Filter and a "best grade" Ceramic Filter. Result? . . . better sensitivity, more intermodulation rejection and the smoothest sounding radio in its class ■ You choose from Noise Activated Squelch, Continuous Tone Squelch or Sequential Two-Tone Squelch ■ Listen to clear "Voice-Fidelity" audio ■ The transmitter sounds better because of the Sonar engineered microphone and speech circuitry ■ Choose the powerful 25 watt or the economical 10 watt model ■ A 110VAC operated regulated power supply is available for base station use ■ Our prices includes mobile mount hardware, detachable microphone, and 1 pair of precision cut crystals ■ These 4 flexible units allow you to custom design a mobile or base model to fit your specific needs. Why don't you visit your local dealer or write.

10 WATTS OUTPUT 1 channel \$350.00  
4 channels 395.00

25 WATTS OUTPUT 1 channel \$450.00  
4 channels 495.00

**SONAR RADIO CORPORATION** 73 WORTMAN AVE., BROOKLYN, N.Y. 11207

Sonar has a complete line of VHF-FM-2 way radios -Base, mobile or hand held portable operation for new systems or adding on existing systems.



**PROFESSIONAL DEPENDABILITY PERFORMANCE**

*You always will get thru!*  
ready for action in the toughest situations

**VHF-FM Model 2305 TRANSCIVER PORTABLE**  
1 CHANNEL (132-174 MHz)

A compact, lightweight, versatile transceiver. Ideal as a companion piece to the FM-2100. It is better designed and better built by Sonar for durability and long life use.

- Provides immediate voice contact with base stations, mobile units and other portable transceivers
- Compatible with ALL 2-way systems
- Fast charge snap-in battery pack operated on independent frequencies
- with 1 pair crystals less batteries

**\$375.00**

Circle 74 on reader service card

## HARD ROCK AND HEARING

(continued from page 68)

lected in order to have the same instruments in all the records. The music was played at levels varying from 100 to 120 dB. By carefully positioning the loudspeakers, the same level was obtained throughout the room.

After three hours of dancing (no strong drinks were allowed), another audiogram was made for each student. The average results of both measurements are shown in Fig. 2.

Boys showed an average hearing loss of about 10 dB, while girls showed a loss of only about 6 dB. Of course, these preliminary results are in no way conclusive. But they are thought-provoking. I was unable to make audiograms of the students for the next day in order to measure hearing recovery, if any was present.

Although we know very little about the possible dangers of music played at high levels, we may summarize our present knowledge as follows:

Sound levels below some 80 dB may be considered absolutely harmless, unless exposure to them is very long.

The hearing of most people begins to be impaired at 100 dB, and in

some cases probably, at 90 dB. Music at these levels may prove dangerous for the inner ear.

People under 25 are more likely to suffer from exposure to high sound levels than are middle-aged persons.

Music played at high levels will lift the hearing threshold of practically any keen-eared youth beginning at 2,000 to 3,000 Hz where the ear is most sensitive, but we do not know if this impairment is permanent.

It is known that musicians in military bands become hard of hearing at an early age. That probably will be the case for people who play elec-

tronic instruments at high volume.

Using earphones for listening to music or practicing with an electronic instrument is equally dangerous if high volume is used. I have found youngsters sometimes introduce 120 dB into their ears with earphones.

To lessen dangers to your hearing, never practice with an electronic guitar or any other high-level instrument in a small room with closed doors or windows. It's preferable to deal with angry neighbors than risk a hearing loss. If you play for long periods for profit or fun, use ear plugs to reduce the sensitivity of your ears. R-E

# SPRAY AWAY THE RACKET.



Squeak. Whine. Whirr. Pssst! Silence. Quietrol did it again. Silenced those moving T.V. parts, with one squirt from the handy spray pack. Cleaned away dirt, dust, and crud. Without damaging anything... in any black and white or color set. Silence is golden. So is Quietrol.

Also available in bottles, and the new Silicron—"Silitrone."

Product of

**QUIETROL**  
COMPANY

Spartanburg, South Carolina

Circle 75 on reader service card

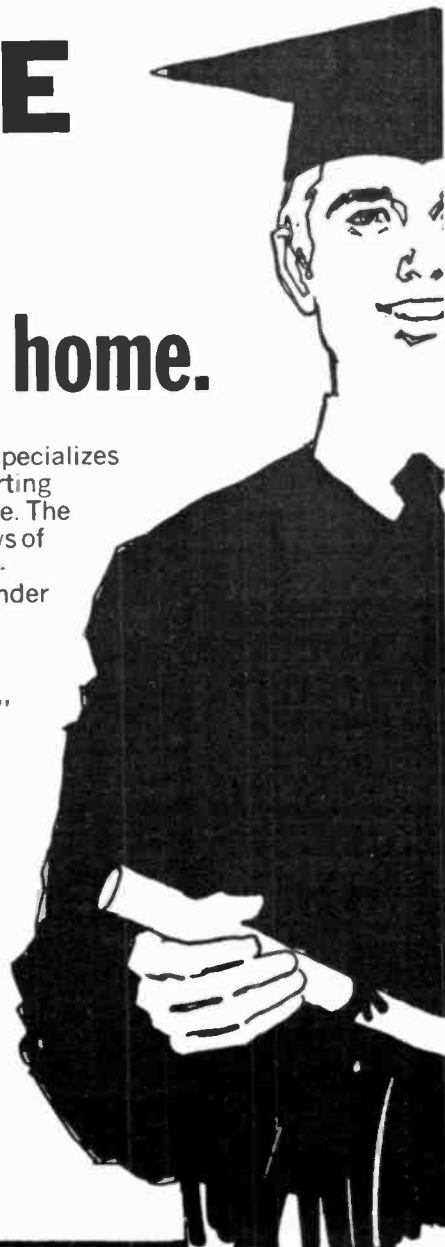
# Earn Your Electronics DEGREE mainly by studying at home.

Grantham School of Engineering specializes in teaching electronics and supporting subjects, mainly by correspondence. The School is authorized under the laws of the State of California to grant academic degrees, and is approved under the G. I. Bill.

The A. S. E. T. Degree is offered in four "correspondence semesters" plus a one-week residential seminar. Then, the B. S. E. E. Degree is obtainable through further residential training in engineering subjects and transfer credits in the humanities. For complete information, write for our free BULLETIN A-73.

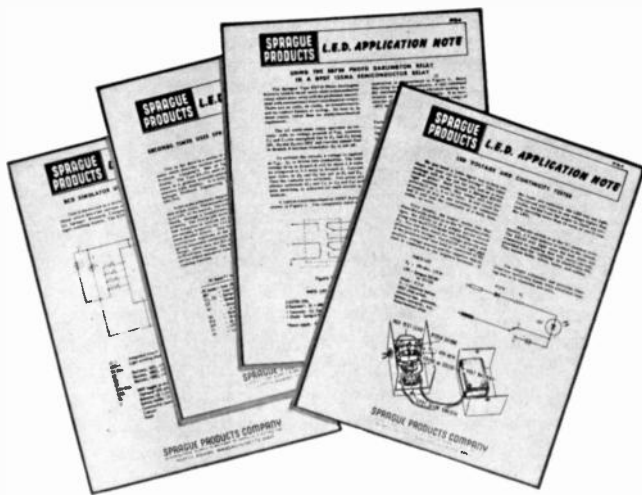
**GRANTHAM**  
School of Engineering

1505 N. Western Avenue  
Hollywood, CA 90027



Circle 76 on reader service card

MARCH 1973 • RADIO-ELECTRONICS



# FREE

## L.E.D. Application Notes to help you do new things with new circuits!

Now . . . get four **free** Application Notes hot-off-the-press that describe various uses and circuits for Sprague LED devices. Notes cover a BCD simulator, seconds timer, voltage and continuity tester, and an all-solid-state semiconductor relay. They've been prepared specifically to help open up a new world of electronic experimentation for **YOU**.

Ask your distributor for copies, or write our Guy Ezelle at Sprague Products Co. Better yet, fill out and mail coupon today!

**Sprague Products Company**  
81 Marshall St., North Adams, Mass. 01247  
Attention: Mr. Guy Ezelle

YES . . . send me free L.E.D. application notes on:

- BCD Simulator     Voltage & Continuity Tester  
 Seconds Timer     Semiconductor Relay

Name.....

Address.....

City.....

State.....

Zip.....



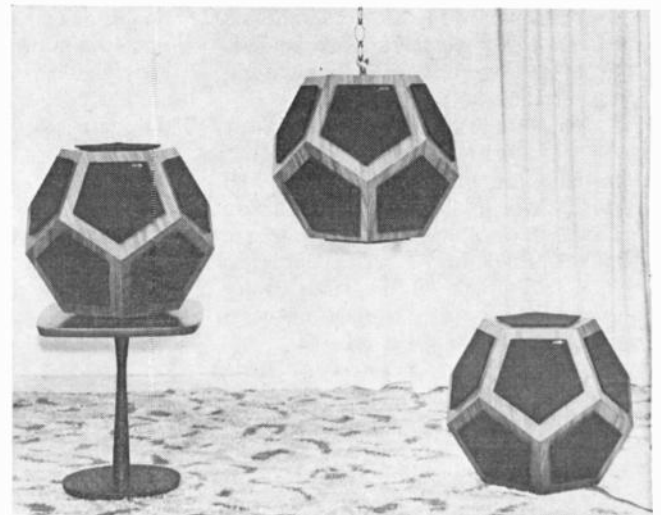
68-2117

Circle 77 on reader service card

### OFF-BEAT SPEAKERS (continued from page 50)

dispersion pattern, the systems are ideal for use in modern decorating schemes, but can also be effective in traditional decor.

Another multi-duty model for ceiling suspension, pedestal, or direct on-the-floor use comes from Carlu Manufacturing Co., Gardena, California. This 12-sided sphere



**TWELVE-SIDED SPHERES** are speaker systems by Carlu. Models are for ceiling suspension, pedestal or on-the-floor locations.

contains four 3½-inch tweeters, midrange, and a six-inch woofer, arranged for a 360-degree dispersion pattern. The system—called the Carlu Six—has a claimed frequency response of 40 to 20,000 Hz. Framework of the Carlu Six is of simulated or genuine walnut, and the design would be appropriate to virtually any decor. Prices are \$79.95 for simulated walnut finish, and \$99.95 for genuine walnut.

Electroponic Corp. of America also has spherical speaker systems, some for ceiling suspension, some for pedestal mounting. There are 10 models, ranging from \$64 to \$126 per pair. They range in size from 11 to 13 inches in diameter. Five models use 6½-inch full-range speakers, the rest use two speakers, of various sizes. But more! Two models additionally function as hanging lamps. Two function as swag-lamp psychedelic speaker systems which, a brochure notes, "provide a thrilling and unusual effect, the multicolor light system in the lower half perfectly coordinated with the program material to illuminate and glow with the signal." And two models function as pedestal-sphere psychedelic light speaker systems, with light-to-music emanating from the top half of the spheres.

#### Lamp, clock, table, and novelty models

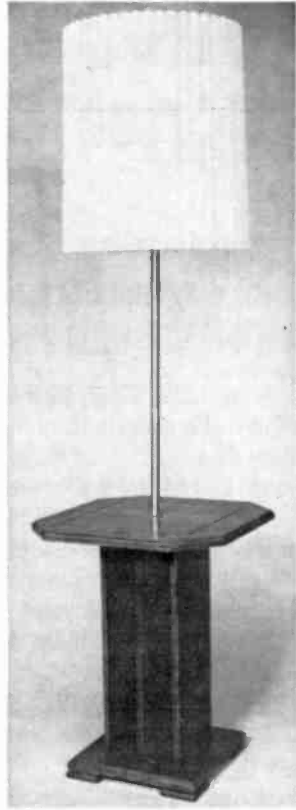
Two other companies have come on the scene with speaker products that represent a frank wooing of both factions in a 4-channel "expression of wills." They are Dee Gee Products, Chicago, and Richards Manufacturing Co. of Los Angeles. Dee Gee has perhaps the largest assemblage of off-beat speaker systems designed primarily for back-channel use in 4-channel applications. They are available as 12 models of stack tables, commode tables, cube tables, and end tables in modern, colonial and contemporary designs. They also come as: 36 models of floor lamps, four price ranges of table lamps, hanging lamps in nine styles; as four models of wall clocks; as a wall plaque in the shape of a barrel end; and—hold your breath—guitars, ukuleles, banjos and bongo drums. The table models use either wide-range four-inch or 5¼-inch single speakers, or a combination of 6½-inch woofer-midrange and 3-inch tweeter. The lamp



units and other models use either a 4-inch or 5¼-inch single speaker. All connecting cords are 18-feet long. The lamp models come in five furniture styles.

Richards Manufacturing has devised a line of lamps in table and hanging form incorporating wide-range speakers

**MODEL 143 CLOCK AND MODEL 110 LAMP TABLE** are but two of the approximately 36 different off-beat speaker systems by Dee Gee.



and with a 360-degree dispersion pattern. The devices will most certainly appeal to The Keeper of the Decor in that they are rather elegant, embracing 13 models (eight table, five hanging) covering modern, Mediterranean and traditional design concepts. The 8-inch speakers are mounted within the confines of the shade and are not visible to the casual eye. Their frequency response is said to be 30 to 19,000 Hz. They are priced between \$69.95 and \$89.95.

And that's it . . . We hope you'll find among the foregoing an approach that will win over The Little Woman, and satisfy your yen for quadrasonic sound. **R-E**

#### LIST OF MANUFACTURERS

- Acoustic Fiber Sound Systems, 2831 N. Webster Ave., Indianapolis, Ind. 46219
- Carlu Manufacturing Co., 18002 S. Hobart Blvd., Gardena, Calif. 90248
- Dee Gee Products, 5415 N. Clark Street, Chicago, Ill. 60640
- Electroponic Corp. of America, 101-10 Foster Ave., Brooklyn, N.Y. 11236
- EPI (Epicure Products, Inc.), 1 Charles Street, Newburyport, Mass. 01950
- Equasound Co., 3330 S. Sepulveda Blvd., Los Angeles.
- Fisher Radio Corp., 11-35 45th Road, Long Island City, N.Y. 11101
- Hi-Vi Systems, 3817 South El Camino Real, San Clemente, Calif. 92672
- JBL (James B. Lansing Sound, Inc.), 3249 Casitas Ave., Los Angeles, Calif. 90039
- JVC America, Inc., 50-35 56th Road, Maspeth, N.Y.
- Magitran Co., 311 East Park Street, Moonachie, N.J.
- Richards Manufacturing Co., 4505 Bandini Blvd., Los Angeles, Calif. 90040
- Sound West, Inc., 14201 Bessemer, Van Nuys, Calif.

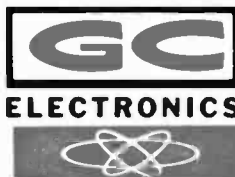
Printed

# kits

## FOR THE HOBBYIST & PROFESSIONAL

**FREE**

**PRINTED CIRCUIT HANDBOOK  
WHEN YOU TAKE THIS AD TO  
YOUR ELECTRONIC SUPPLIER.**



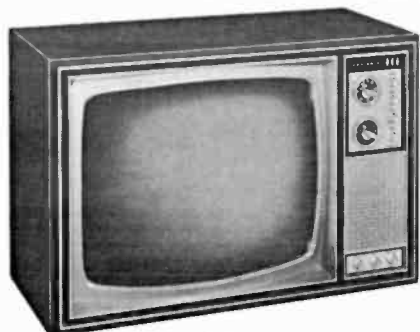
**GC ELECTRONICS**

DIVISION OF HYDROMETALS, INC.  
ROCKFORD, ILLINOIS 61101 U.S.A.



# Save on Heathkit® Color TV...

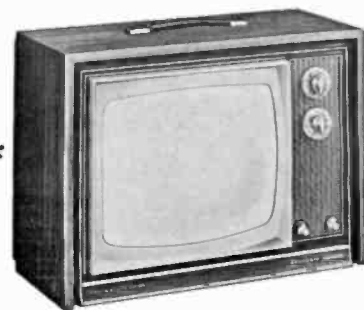
**Save  
\$50<sup>00</sup>\***



**Price reduced on  
18 in. diagonal Color TV — was 399.95\*  
NOW 349.95\*** (less cabinet)

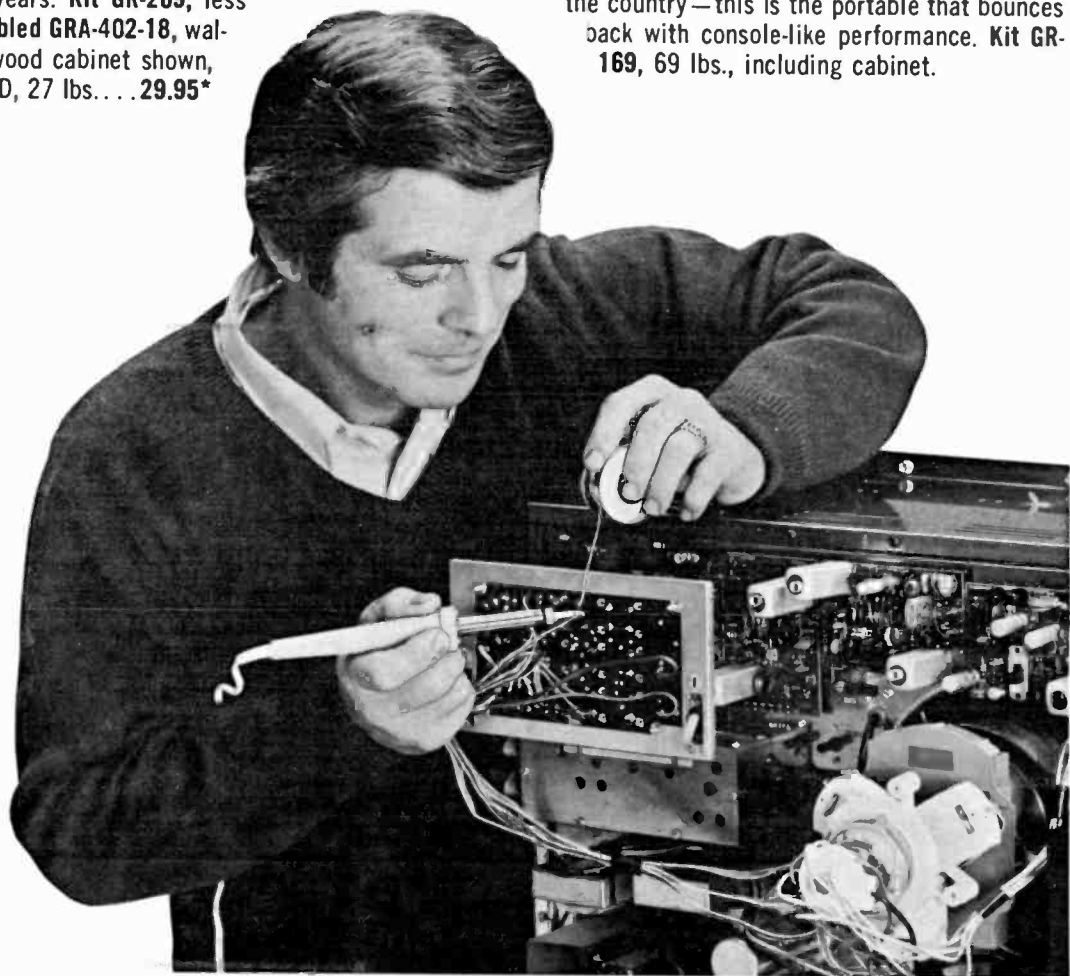
Solid-state modular circuitry spells reliable operation and easy assembly. And as in all Heathkit TVs, the GR-269 comes with a full complement of alignment and self-service equipment — dot generator, convergence board, test meter and troubleshooting book. Factory assembled and aligned AFT module for perfect picture and sound at a touch. VHF tuner with MOSFET circuitry for high sensitivity, superior reception under marginal conditions. UHF tuner with hot-carrier diode design for low noise, high sensitivity. Both tuners factory assembled and aligned as is the 3-stage IF assembly. "Instant-on", switch-controlled degaussing, hi-fi sound output; 75 and 300 ohm antenna inputs; exclusive Heath Magna-Shield, standard. Picture tube warranted 2 full years. Kit GR-269, less cabinet, 100 lbs. Assembled GRA-402-18, walnut-grained vinyl clad wood cabinet shown, 16½" H x 25" W x 11" D, 27 lbs. . . . 29.95\*

**Save  
\$50<sup>00</sup>\***



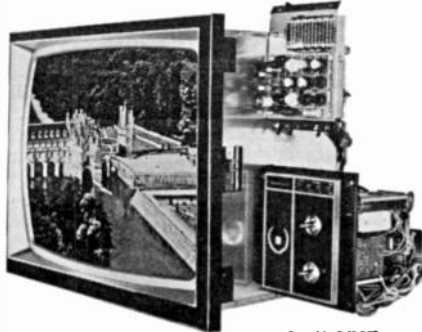
**Price reduced on  
14 in. diagonal Portable Color TV —  
was 349.95\* NOW 299.95\*** (includes cabinet)

Set aside about a dozen evenings. Build-up 10 circuit boards, prepare the chassis, terminals and connectors. Install and solder the wiring harness and point-to-point conductors. Result: the Heathkit GR-169, with picture purity and brightness that puts it at the top of its class. And, thanks to built-in maintenance equipment, you keep it that way — with plug-in modular circuit boards, troubleshooting meter and data book to help you fix it right at home. A "big" little TV, the GR-169 has all the secondary controls found in our larger models — color, tint, contrast, horizontal and vertical hold, height, AGC, color killer, switch-controlled degaussing. Measures a compact 16" H x 20½" W x 16" D. Carry it from room to room or across the country — this is the portable that bounces back with console-like performance. Kit GR-169, 69 lbs., including cabinet.



# and on 350 other electronic kits in the FREE '73 Heathkit Catalog

Our best 25 in. diagonal solid-state Color TV ... 599.95\* (less cabinet)



Power detent selection of all VHF and any 12 pre-selected UHF channels; exclusive angular tint control for consistently better flesh tones; voltage controlled varactor UHF tuner and MOSFET VHF tuner for unmatched sensitivity; black matrix tube, built-in dot generator, convergence panel and volt-ohm meter — full remote control options, too. It's Heathkit TV at its finest. Kit GR-900, less cabinet, 125 lbs.

NEW 4-Channel Amplifier with "Universal" decoder circuitry... 359.95\* (less cabinet)



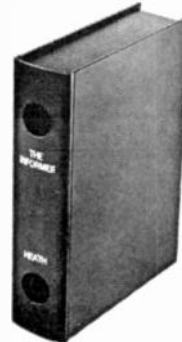
You select discrete 4-channel, or switch-in the "Universal" decoder for reproduction of all the matrixed 4-channel discs now on the market, plus "derived" 4-channel from conventional stereo. Four solid-state amplifiers produce 200 watts (4x50 IHF) into 8 ohms, with power bandwidth on all channels from less than 5 Hz to greater than 45 kHz at 0.25% distortion. Kit AA2010, 37 lbs. AAA-2004-1, pecan cabinet, 7 lbs. 24.95\*

NEW "Universal" 4-Channel Decoder... 39.95\*



Reproduces all matrixed discs, plus "derived" 4-channel from conventional stereo materials. Plug it into your receiver's tape monitor circuit, add a second stereo amp and speakers and you're set. Kit AD-2022, 4 lbs.

NEW Ultrasonic Intrusion Alarm... 49.95\*



Disguised as an ordinary library book, this novel device fits unobtrusively anywhere in the home. Transmitter disperses a 41 kHz signal which bounces off walls and returns to the receiver where it's monitored for any change in amplitude. Triggers lights and any conventional alarm device — just plug them into AC outlets on the rear panel. Can be installed anywhere there's a 120 VAC outlet. An enjoyable 2-evening kit. Kit GD-39, 5 lbs.

NEW Cassette Deck with Dolby circuitry... 249.95\*



A kit-form cassette deck utilizing the famous Dolby® noise reduction system. Accommodates the greater fidelity and dynamic range of chromium dioxide cassettes. Independent switches provide Dolby on/off and regular or CrO<sub>2</sub> bias control. Domestic-make tape transport comes preassembled for easy kit building. Kit AD-1530, 21 lbs.

NEW 6-Digit Electronic Alarm Clock... 54.95\*



Displays hours, minutes and seconds on highly visible cold-cathode readout tubes. A gentle "beeper" alarm can be set for 24-hour cycle and features a snooze switch that gives you seven more minutes of sleep before the alarm sounds off again. Conventional 12-hour or 24-hour international time display. Kit GC-1005, 4 lbs.

See them all at your Heathkit Electronic Center... or send for Free '73 Heathkit Catalog.

## HEATHKIT ELECTRONIC CENTERS

ARIZ.: Phoenix, 2727 W. Indian School Rd.; CALIF.: Anaheim, 330 E. Ball Rd.; El Cerrito, 6000 Potrero Ave.; Los Angeles, 2309 S. Flower St.; Pomona, 1555 Orange Grove Ave. N.; Redwood City, 2001 Middlefield Rd.; San Diego (La Mesa), 8363 Center Dr.; Woodland Hills, 22504 Ventura Blvd.; COLO.: Denver, 5940 W. 38th Ave.; CONN.: Hartford (Avon), 395 W. Main St. (Rte. 44); FLA.: Miami (Hialeah), 4705 W. 16th Ave.; GA.: Atlanta, 5285 Roswell Rd.; ILL.: Chicago, 3462-66 W. Devon Ave.; Downers Grove, 224 Ogden Ave.; IND.: Indianapolis, 2112 E. 62nd Ave.; KANSAS: Kansas City (Mission), 5960 Lamar Ave.; MD.: Baltimore, 1713 E. Joppa Rd.; Rockville, 5542 Nicholson Lane; MASS.: Boston (Wellesley), 165 Worcester St.; MICH.: Detroit, 18645 W. Eight Mile Rd. & 18149 E. Eight Mile Rd.; MINN.: Minneapolis (Hopkins), 101 Shady Oak Rd.; MO.: St. Louis, 9296 Gravois Ave.; N.J.: Fair Lawn, 35-07 Broadway (Rte. 4); N.Y.: Buffalo (Amherst), 3476 Sheridan Dr.; New York City, 35 W. 45th St.; Jericho, L.I., 15 Jericho Turnpike; Rochester, Long Ridge Plaza; OHIO: Cincinnati (Woodlawn), 10133 Springfield Pike; Cleveland, 5444 Pearl Rd.; PA.: Philadelphia, 6318 Roosevelt Blvd.; Pittsburgh, 3482 Wm. Penn Hwy.; TEXAS: Dallas, 2715 Ross Ave.; Houston, 3705 Westheimer; WASH.: Seattle, 221 Third Ave.; WIS.: Milwaukee, 5215 Fond du Lac.

HEATH

Schlumberger

HEATH COMPANY, Dept. 20-3  
Benton Harbor, Michigan 49022

Please send FREE Heathkit Catalog.

Enclosed is \$ \_\_\_\_\_, plus shipping.

Please send model(s) \_\_\_\_\_

Name \_\_\_\_\_

Address \_\_\_\_\_

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

Prices & specifications subject to change without notice.  
\*Mail order prices; F.O.B. factory CL-461

# Free! 1973 Eico Catalog

OVER 200 INSTRUMENTS • KIT & WIRED!

NEW! TR-410 Solid State Triggered Sweep Scope  
 NEW! 300C "Clamp-On" Current Tester  
 NEW! TD-8 8 Track Stereo Tape Deck  
 NEW! SS-200 "Time Delay" Burglar Alarm System  
 NEW! ASA-300 Electronic Siren Auto Alarm

Build all-professional Eico Kits and save up to 50%. The more you know about electronics, the more you'll appreciate Eico. Over 2500 local Eico dealers offer you all the top brands, personal technical counsel, fast off-the-shelf service. Free catalog includes Test Equipment, Stereo, Eico-craft Projects, Burglar/Fire Alarm Systems and name of nearest Eico distributor, check reader service card or send 25¢ for first class mail service.

EICO, 283 Malta St., Brooklyn, N.Y. 11207  
 Leadership in creative electronics since 1945



Circle 79 on reader service card

## new books

**HOW TO INTERPRET TV WAVEFORMS**, by Forest H. Bell. TAB Books, Blue Ridge Summit, Pa. 17214. 5 1/2 x 8 1/2 in. 256 pp. Hardcover, \$7.95; Softcover, \$4.95.

A comprehensive photo/text guidebook created specifically to clear up many of the mysteries of TV waveforms for the service technician. More than 250 waveform photographs in this volume have been collected through intensive study of television circuit breakdowns. Every one is authentic, actually taken from a set that has malfunctioned. Not only does the book show specifically what normal waveforms should look like at key test points, it shows what happens to each key waveform under various component fault conditions.

**ABC'S OF BOOLEAN ALGEBRA**, by Allan Lytel and Lawrence Buckmaster. Howard W. Sams & Co., Inc., 4300 W. 62 St., Indianapolis, Ind. 46268. 5 1/2 x 8 1/2 in. 128 pp. Softcover, \$3.50; in Canada, \$4.40.

Boolean algebra is the algebra of logic, an abstract mathematical structure appearing in three different forms—a switching algebra, a propositional calculus and an algebra of sets. With simple block diagrams, this book shows you the relationship between language and switches, the principles of logical design and examples of the application of these principles. It tells you how to write logical expressions, how to expand and simplify them and how to use relays and switches in simple practical circuits.

**USING ELECTRONIC TESTERS FOR AUTOMOTIVE TUNE-UP**, by Albert Wanninger. TAB Books, Blue Ridge Summit, Pa. 17214. 5 1/2 x 8 1/2 in. 256 pp. Hardcover, \$7.95; Softcover, \$4.95.

An all-in-one manual that provides complete information and operating instructions for all commonly-available electronic devices used for auto tune-up. Starting with simple voltage and continuity checks, the author continues through the more involved procedures, employing os-

# BEST DOLLAR BUYS

FREE \$1 BUY WITH EVERY 10 YOU ORDER Only applies to "\$1" Buys FREE GIFT WITH EVERY ORDER

**SARKES TARZIAN TUNER**  
41mc



Latest Compact Model good for all 41 mc TV's. BRAND NEW—

Best TUNER "SARKES TARZIAN" ever made—last word for stability, definition & smoothness of operation. An opportunity—to improve and bring your TV Receiver up-to-date. \$7.95

COMPLETE with Tubes

- UHF TUNER — TRANSISTOR \$3.95  
TYPE Used in all TV sets
- STANDARD TUNER — TRANSISTOR (GUIDED GRID) 4 Channel closed circuit \$1
- PHILCO TV TUNERS  
Model—76-13983-8 (50J7— \$4.95  
3HQ5)
- GE — TV TUNERS \$5.95  
Model—ET 86X314 (5LJ8-3GK5)
- GE — STANDARD COIL TV TUNER  
Model EU-S6XI (6HQ5—6GJ7) \$7.95  
Model—ET 86X304 (6LJ8—6HA5)
- TV TUNERS VHF/UHF all new standard makes, including Tubes \$7.95
- ALL NEW TV TUNER Standard makes — less tube \$1

- 12" UNIVERSAL SPEAKER \$4.89  
Top Quality . . . Large Magnet
- 10" PHILCO SPEAKER \$2.99  
Top Quality . . . Large Magnet
- 8" UNIVERSAL SPEAKER — \$2.99  
Large Magnet—Special Buy
- 5" UNIVERSAL TWEETER \$1.29  
1 Oz. . . Magnet
- UNIVERSAL 4" PM SPEAKER \$1  
Top Quality
- 2 1/2" x 4" SPEAKER \$6.95 Ea.  
Special Buy 10 For \$5—
- 4" X 6" "QUAM" 16 OHM SPEAKER Large magnet . . . \$1.79  
Special BUY (10 for \$15.00)
- RONETTE STEREO CARTRIDGE \$2  
latest dual sapphire slipover type
- STEREO HEADPHONES Hi-Fi Quality . . . Complete \$5.95  
with Stereo plug
- COLOR POWER TRANSFORMER — Good for most sets 20R180 \$6.95  
List Price—\$36.75
- 4-50' HANKS HOOK-UP WIRE \$1  
assorted colors
- 100'—SPOOL SPEAKER WIRE \$1.50  
2 cond, mini slip, clear, 101 uses
- 10 — ASST. RADIO & TV TUBES \$1  
Every Tube a good number
- 5 — AUDIO OUTPUT TRANSFORM Sub-min for Trans Radios \$1
- 5 — I.F. COIL TRANSFORMERS \$1  
456-kc for Transistor Radios
- 6" UNIVERSAL SPEAKER Top quality Special buy \$1.29 Ea.  
5 for \$5
- ALL AMERICAN TUBE KIT \$2.99  
(12AV6-12BR6-12BA6-35W4-80CS)
- 70° COLOR TUBE BRIGHTNER \$3.95
- 90° COLOR TUBE BRIGHTNER \$4.95

- 2 — COLORBURST QUARTZ CRYSTAL For Most Color TV sets 3579.845 KC \$1.89
- 2 — ELECTROLYTIC CAPACITORS CD — 40/40 MFD — 450 Volts \$1
- SPECIAL TUBE BUY \$1  
4 — 18FYG American made
- 1—6" x 9" HEAVY DUTY 10 OZ. SPEAKER Ceramic Type \$3.95  
8 Ohm
- 5 ASSTD. GLOBAL VARISISTOR Popular replacements for most COLOR TV \$1
- 10 — SETS PHONO PLUGS & PIN JACKS RCA type \$1
- 8—PRINTED CIRCUIT IF TRANSFORMERS 4-Lug, 456 KC \$1
- STEREO TONE ARMS Most popular type—turn over cartridge \$2
- CO-AX CABLE RG59U 675' or \$2  
black 250'—\$9 100'—\$9.99 50'—
- 4 — TV ALIGNMENT TOOLS most useful assortment #1 \$1
- 4 — TV ALIGNMENT TOOLS For Color TV #2 \$1.49
- 6 — TV COLOR ALIGNMENT TOOLS Most popular type \$2.79
- 5 — 9 VOLT MOTORS Excellent for hobbyist \$1
- 200' — #24 SOLID PUSH BACK WIRE Yellow or Black excellent buy \$1
- UNIVERSAL TV ANTENNA Back of set mounting . . . \$1.99  
5 section rods
- 2 — ELECTROLYTIC CONDENSERS 200/30/4 mfd — 350V \$1
- 8-TRACK TAPE PLAYBACK DECK Compact design fits anywhere \$27.50

**KNOB SPECIAL**

- 100 — ASSORTED RADIO KNOBS All standard types \$20 value \$1
- 50 — TV KNOBS — POPULAR TYPES Mostly Selector & Fine Tuning \$1
- 25 — VERTICAL LINEARITY KNOBS Long shank . . . Front mount . . . miniature assortment \$1
- 20 — VERTICAL LINEARITY KNOBS . . . Side mount . . . Standard sizes \$1
- 25—KNURLED RADIO KNOBS Hard to get . . . Best selection \$1
- 40 — DELUXE RADIO KNOBS Choice assortment . . . Popular types \$1

ANY 6 KITS FOR \$5

- TRANSISTOR RADIO any type good, bad, broken, as-is, potluck \$1.50
- TAPE RECORDER—assorted types good, bad, broken, as-is, potluck \$4
- 300 — ASST. 1/2 W RESISTORS Top Brand, Short Leads, Excellent Selection \$1
- 100—ASST 1/4 WATT RESISTORS stand, choice ohmages, some in 5% \$1
- 100—ASST 1/2 WATT RESISTORS stand, choice ohmages, some in 5% \$1
- 70 — ASST 1 WATT RESISTORS stand, choice ohmages, some in 5% \$1
- 35 — ASST 2 WATT RESISTORS stand, choice ohmages, some in 5% \$1
- 50 — PRECISION RESISTORS asst. list-price \$50 less 98% \$1
- 20 — ASSORTED WIREWOUND RESISTORS, 5, 10, 20 watt \$1
- 10—ASSORTED SLIDE SWITCHES SPST, SPDT, DPDT, etc. \$1

IMMEDIATE DELIVERY . . . Scientific light packing for safe delivery at minimum cost. HANDY WAY TO ORDER: Pencil mark or write amounts wanted in each box, place letter F in box for Free \$1 BUY. Enclose with check or money order, add extra for shipping. Tearsheets will be returned as packing slips in your order, plus lists of new offers. Minimum Order \$3.00

Name . . . . . Cost of goods . . . . .  
 Address . . . . . Shipping . . . . .  
 . . . . . estimated . . . . .  
 . . . . . TOTAL

Please specify refund on shipping overpayment desired:  CHECK  POSTAGE STAMPS  MERCHANDISE (our choice) with advantage to customer

**BROOKS RADIO & TV CORP., 487 Columbus Ave., New York, N. Y. 10024** 212-874 5600 TELEPHONE

cilloscopes and specialized testers and ends with complete automotive tune-up on console-type analyzers. Brief discussions of how the equipment operates is included to make the meter indications more meaningful to the technician.

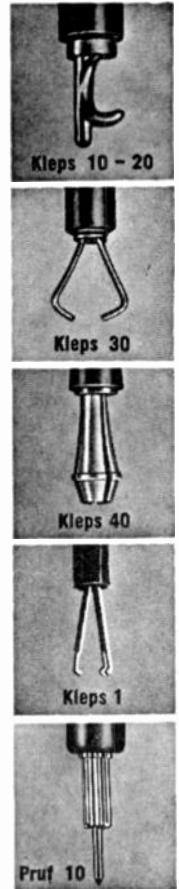
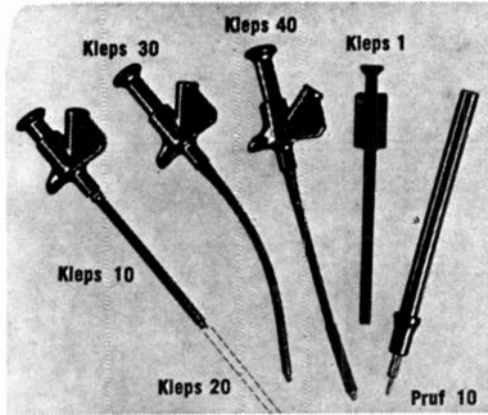
**MODERN DICTIONARY OF ELECTRONICS, Fourth Edition, by Rudolf F. Graf. Expanded & Revised. Howard W. Sams & Co., Inc., 4300 West 62nd Street, Indianapolis, Indiana 46268. 6 1/2 x 8 1/2 in. 688 pp. Hardcover, \$12.95.**

As new technologies evolve, fresh terminology must be developed to communicate, describe and define the previously unknown concepts, components and techniques. Here's where this fourth edition of a popular electronics dictionary plays a vital role. This latest work contains concise definitions of more than 18,000 terms in electronics, communications, microelectronics, fiberoptics, semiconductors, reliability, computers and medical electronics. Approximately 2,000 terms have been added and hundreds of existing definitions have been updated.

**199 COLOR TV TROUBLES & SOLUTIONS, by Robert L. Goodman. TAB Books, Blue Ridge Summit, Pa. 17214. 5 1/2 x 8 1/2 in. 224 pp. Hardcover, \$7.95. Softcover, \$4.95.**

This is an all-in-one case history book of "tough dog" and recurring troubles that can save TV service technicians many frustrating hours of troubleshooting time. It describes 199 actual problems gleaned from the author's extensive case history file and offers practical solutions to them. Virtually all of the case histories are accompanied by a schematic diagram and in every case a complete description of the symptoms and the cure is included. The content is arranged by brand names, from Admiral to Zenith. This comprehensive guide should increase the technician's ability to pinpoint other troubles, as well as those described in the book, more quickly.

R-E



## 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. \$1.19
- Kleps 20.** Same, but 7" long. \$1.39
- Kleps 30.** Completely flexible. Forked-tongue gripper. Accepts banana plug or bare lead. 6" long. \$1.47
- 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. \$2.39
- 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. \$ .79

All in red or black — specify. For additional information, 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.**  
128 Spencer Place, Mamaroneck, N.Y. 10543  
In Canada: Rye Industries (Canada) Ltd.

Circle 80 on reader service card

**CANADIANS: Ordering is easy — we do the paperwork — try a small order**

**IBM COMPUTER SECTIONS**

8 assorted Units we sell for \$1 are loaded with over 150 valuable parts.

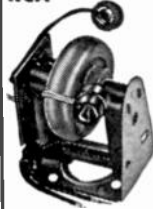
Incl. — Transistors  
Condensers, Resistors, Heat Sinks, Diodes, Etc.

**8 for \$1**  
**100 for \$10**

### WESTINGHOUSE ALL TRANSISTOR HOME/OFFICE MESSAGE CENTER

Leaves messages for other for replay . . . Built in speaker/microphone for talk-into convenience . . . Records up to 3 minutes of messages . . . Illuminated signal shows when a message is waiting. Control adjusts playback volume without affecting recording volume . . . Capstan Drive;  
**BRAND NEW SOLD AS IS \$7.95**

### RCA 110" FLYBACK TRANSFORMER



We scooped the Market Latest type — standard for all 110" TV's  
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  
10% off in lots of 3

**110" TV DEFLECTION YOKE \$3.95**  
for all types TV's incl schematic

**"COMBINATION SPECIAL" RCA 110" FLYBACK plus 110" DEFLECTION YOKE \$5.95**

**90" FLYBACK TRANSFORMER \$2.95**  
for all type TV's incl schematic

**90" TV DEFLECTION YOKE \$2.95**  
for all type TV's incl schematic

**70" FLYBACK TRANSFORMER \$2**  
for all type TV's incl schematic ..

**70" TV DEFLECTION YOKE \$2**  
for all type TV's incl schematic ..

**SHARP 110" FLYBACK & YOKE COMBINATION #87T. \$5.00**  
592 Good for most portable TV.

**90" COLOR YOKE For all Rectangular 19 to 25" Color CRT's \$10.95**

**RCA COLOR FLYBACK Part #113382 (Stancor #EO-601C) \$12.95**

### COLOR CONVERGENCE ASSEMBLY Universal type— \$2.49

good for most sets ..

**COLOR-TV RECTIFIER — \$1.99**  
Used in most color sets — 3 for \$4.99  
6500 kv ..

**10 — STANDARD TRANSISTORS \$1**  
NPN & PNP 2N404, 2N414, etc. ..

**10—ASSORTED DIODE CRYSTALS \$1**  
1N34, 1N48, 1N60, 1N64, etc. ..

**6 — TOP BRAND SILICON REC. \$1**  
TIFIERS 1 amp. 1000 PIV ..

**5 — PNP TRANSISTOR \$1**  
general purpose, TO-5 case ..

**5 — NPN TRANSISTORS \$1**  
general purpose, TO-5 case ..

**50 — ASSORTED TRANSISTORS \$1**  
big factory scoop—sold as-is ..

**TV TWIN LEAD-IN 800 ohm \$1**  
500' — \$7 100'—\$1.50 50' ..

**12—MINIATURE ELECTROLYTIC CONDENSERS For Transistor & miniature work .. \$1**

**6 — MINIATURE ELECTROLYTIC CAPACITORS 5 MFD—150 V. .. \$1**

**3—ELECTROLYTIC CONDENSERS \$1**  
100 mfd.—100 V, 50 mfd.—75 V ..

**2—ELECTROLYTIC CONDENSERS \$1**  
C.D. 500 mfd—200 volts ..

**2—ELECTROLYTIC CONDENSERS UNECAP .. \$1**  
2000/1000 Mfd ..

**30 Volt .. \$1**

**1 — 20 FT. COILED GUITAR CABLE With plugs .. \$2.95**

**1—CASSETTE TYPE DYNAMIC MICROPHONE with universal plugs—200 Ohms .. \$2.49**

**HEAVY DUTY COLOR FOCUS \$1**  
RECTIFIER 14,000 PIV @ 2 MA. ..

### SHANNON MYLAR RECORDING TAPE

3" — 225' ..	.19	CASSETTE C-60 .....	.59
3 1/4" — 600' ..	.58	CASSETTE C-90 .....	1.00
5" — 600' ..	.62	CASSETTE C-120 (TDK) ..	1.97
5" — 900' ..	.80	8 - Track — 64 Min. —	1.29
5" — 1200' ..	.97	8 - Track — 80 Min. —	1.59
5" — 1800' ..	1.49	8 - Track — Cleaner —	1.49
5" — 1200' ..	.77		
7" — 1800' ..	1.12	3" TAPE REEL ....	.06
7" — 2400' ..	1.79	3 1/4" TAPE REEL ....	.07
7" — 3600' ..	2.95	5" TAPE REEL ....	.14
		7" TAPE REEL ....	.15

### MARKET SCOOP COLUMN

**KLEPS "CLEVER" TEST PRODS**  
"Third-hand" test prods, reach into out of way places—insulated, cannot slip—accommodate bare wire or banana plug—no soldering.

<input type="checkbox"/> PRUF 10—VERSATILE TEST PROBE ..	.79
<input type="checkbox"/> KLEPS 10—BOATHOOK CLAMP—4 3/4" long ..	\$1.19
<input type="checkbox"/> KLEPS 20—BOATHOOK CLAMP—7" long ..	\$1.39
<input type="checkbox"/> KLEPS 30—FLEXIBLE—FORKED TONGUE 6" long ..	\$1.47
<input type="checkbox"/> KLEPS 40—FLEXIBLE-PC BOARD TERMINALS 6 1/4" Long ..	\$2.39
<input type="checkbox"/> KLEPS 1—ECONOMY KLEPS—FOR LIGHT WORK ..	.99
<input type="checkbox"/> ASTATIC PICKUP MODEL 700-89T Contains 80T ceramic cartridge LIST PRICE \$17.00 ..	\$2.95
<input type="checkbox"/> 20 — DIPPED MYLAR CAPACITORS .01—600V ..	\$1
<input type="checkbox"/> 20 — DIPPED MYLAR CAPACITORS .033—600V ..	\$1
<input type="checkbox"/> 20 — DIPPED MYLAR CAPACITORS .0033—1000 V ..	\$1
<input type="checkbox"/> 20 — DIPPED MYLAR CAPACITORS .047—400 V ..	\$1
<input type="checkbox"/> 15 — MOLDED TUBULAR CAPACITORS .068—400 V ..	\$1
<input type="checkbox"/> 20 — DIPPED MYLAR CONDENSERS .0033—400 V ..	\$1
<input type="checkbox"/> 10 — SPRAGUE "ORANGE DROP" CAPACITORS .0056—2000 Volt ..	\$1

- WESTINGHOUSE FM TUNER \$2.99 (12DT8 Tube) ..
- WESTINGHOUSE FM TUNER #476-V-015D01 .. Transistor \$3.99
- 300 — ASSORTED HEX NUTS \$1 2/56, 4/40, 5/40, 6/32, 8/32 ..
- 250 — ASST. SOLDERING LUGS \$1 best types and sizes
- 250 — ASST. WOOD SCREWS \$1 finest popular selection ..
- 250 — ASST. SELF TAPPING SCREWS #6, #8, etc. .... \$1
- 150 — ASST. 6/32 SCREWS and 150 6/32 HEX NUTS .. \$1
- 150 — ASST. 8/32 SCREWS and 150—8/32 HEX NUTS .. \$1
- 150 — ASST. 2/56 SCREWS and 150—2/56 HEX NUTS .. \$1
- 150 — ASST. 4/40 SCREWS and 150—4/40 HEX NUTS .. \$1
- 150 — ASST. 5/40 SCREWS and 150—5/40 HEX NUTS .. \$1
- 500 — ASSORTED RIVETS \$1 most useful selected sizes ..
- 300 — ASSORTED WASHERS \$1 most useful selected sizes ..
- 100 — ASST. RUBBER BUMPERS \$1 for cabinet bottoms & other uses ..
- 100—ASSORTED RUBBER GROMMETS best sizes .. \$1

Circle 81 on reader service card

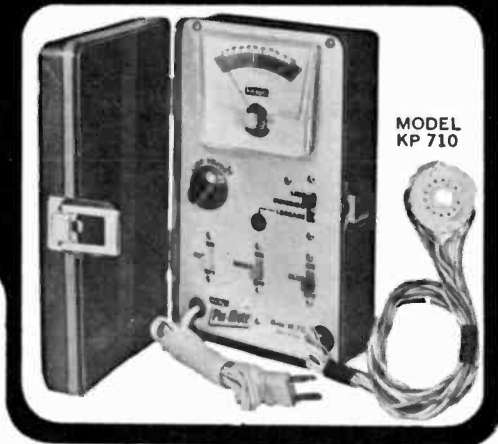


# Pix-Mate™

## the crt tester

### you can afford to take along

only ... \$34.95



- A quality CRT tester with individual test for each gun.
- Compare guns for emission.
  - Test for leakage and shorts.
  - Legible 3 color scale.
  - Compact, portable, rugged.
  - Avoid recalls, check the CRT on every call.

take along the time savers

- PIX-MATE • CRY-S-MATE • GEN-MATE
- SOUND-MATE • TRACE-MATE

The Caddy-Mate Line.

2245 PITKIN AVE., BROOKLYN, N. Y. 11207

WRITE US!

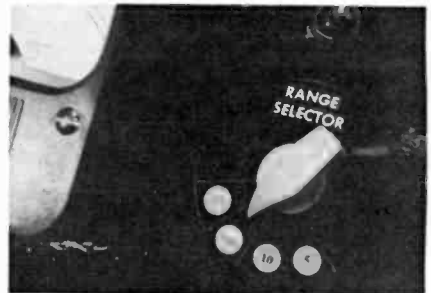
# TeleMatic

Circle 82 on reader service card

# try this

## HANDY PANEL MARKERS

A gimmick borrowed from the photographer can come in handy on your electronics workbench. The small, consecutively numbered dots



used to mark color slides serve well as dial calibrations and panel markers, and can be used to identify terminals or cables. They are inexpensive and can be bought at most camera and stationery stores. They come in vari-

Designed and manufactured in U.S.A.

## NEVER A BURNOUT

IN 4 EMC **DIODE-PROTECTED** VOMS

NOBODY ELSE BUT EMC DESIGNS IN SO MUCH VALUE!

- Professional quality and versatility
- Life-time protection against electrical abuse
- No meter burnout, needle damage, or fuse replacement

### VOLOMETER

Model 109A Factory Wired & Tested \$30.95  
 Model 109AK Easy-to-Assemble Kit \$22.65  
 20,000 Ω/v DC sens. 10,000 Ω/v AC sens.  
 4½", 40μa meter. High impact bakelite case.  
 5 DC voltage ranges: 0-6-60-300-600-3000v.  
 5 AC voltage ranges: 0-12-120-600-1200-3000v.  
 3 DC current ranges: 0-6-60-600ma.  
 3 AC current ranges: 0-30-300ma; 0-3A. 3  
 resistance ranges: 0-20K, -200K, -20 megs.  
 5 db ranges: -4 to +67db. With carrying strap. 5¼" W x 6¾" H x 2¾" D.

### POCKET SIZE VOLOMETER

Model 102A  
 Factory Wired & Tested \$18.95  
 Model 102AK  
 Easy-to-Assemble Kits \$15.95  
 3½", 2% accurate 800μa D'Arsonval type meter. One zero adj. for both res. ranges. High impact bakelite case. 5 AC voltage ranges: 0-12-120-600-1200-3000v. 5 DC voltage ranges: 0-6-60-300-600-3000v. 3 AC current ranges: 0-30-150-600ma. 4 DC current ranges: 0-6-30-130ma; 0-1.2A. Resistance: 0-1K, 0-1 meg. 3¾" W x 6¼" H x 2" D.



Send FREE catalog of complete EMC line and name of nearest distributor.

RE-3

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

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

# EMC

ELECTRONIC MEASUREMENTS CORP.  
 625 Broadway, New York, N.Y. 10012

For faster service

USE ZIP CODE

on all mail

SPECIALS OF THE MONTH				
				Led Large Visible Red 3/\$1.05
				Led MV 50 type 4/\$1.00

7400	7401	7402	7403	
7404	7405	7408	7410	Each \$.20
7420	7430	7440	7460	

LOW POWER DEVICES				
74L00	74L02	74L04		
74L20	74L30	74L51		Each \$.40
74L71	74L72	74L73		

7441	7442	EA. \$.90	7489	EA. \$3.25
7447	7448	EA. .90	7490	EA. .69
7473	EA. .40	7491	EA. 1.05	
7474	EA. .30	7495	EA. .85	
7475	EA. .69	74154	EA. 1.75	
7483	EA. 1.20	74165	EA. 1.75	
7486	EA. .45	74181	EA. 4.50	

LINEAR SPECIALS	
LM309K (T03) 5 volt reg.	EA. \$1.95
LM309H (T05) 5 volt reg.	EA. .95
LM300 Positive volt reg.	EA. .75
LM308 Micro Power Op. amp.	EA. 1.50
NE565 Phase Lock Loop	EA. 2.95
NE566 Function Generator	EA. 2.95
NE567 Tone Decoder	EA. 2.95
709 Op. amp.	35¢ ea. or 10 for \$3.00
741 Op. amp.	45¢ ea. or 10 for \$4.00

CALCULATOR CHIPS	
5001 LSI Calculator Chip	
One Chip Calculator with complete info.	EA. \$9.95

LED DISPLAY	
7 Segment (Man 1) Display	EA. \$3.95
2/10 "Character Height" Man 4 Type	EA. \$3.25

8223 Field Programmable Rom	
256 Bit with 32 8 bit words	
EXTRA SPECIAL	Each \$7.95

Min. order \$4.00 Prepaid in U.S. Orders filled within 3 days after receipt.

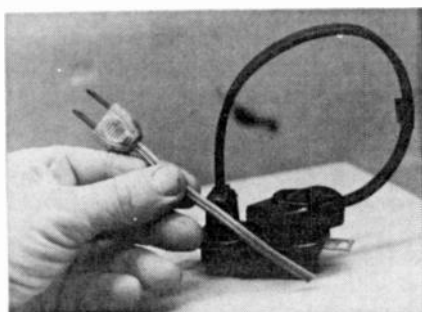
**INTERNATIONAL ELECTRONICS UNLIMITED**

P.O. Box 2238  
 Walnut Creek, Calif. 94595

Circle 83 on reader service card

ous colors with self-adhesive backing which sticks to almost anything. If used for permanent markings on dials or panels, spray or brush the markings with a coat or two of clear varnish.—  
*Frank I. Gilpin*

**SHORTY EXTENSION CORD**  
A "foot-long" extension cord with



multiple sockets at one end will prove extremely useful to any tool user.

**The Most Advanced Design in Color Combo Antennas**



**THE ALL-CHANNEL C.V.U.**

In these antennas the best features of the log periodic and magnetically driven arrays with an exclusive corner reflector magnetic wave UHF section to make it a top performer. The unique feature of this system is the ability to discriminate between desired signal and unwanted noise. Sharp, vibrant life-like color plus FM stereo listening at its finest.

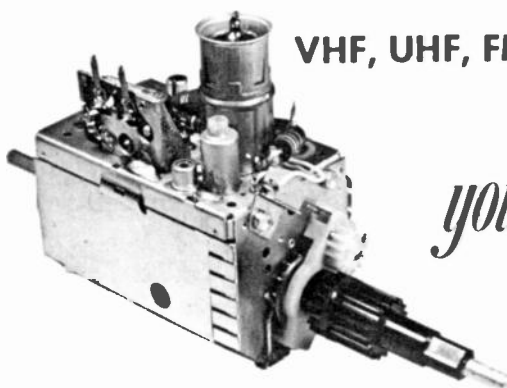
*Investigate now!*  
**S & A ELECTRONICS**  
Phone 419-693-0528  
202 W. Florence St. Toledo, Ohio 43605

Circle 84 on reader service card

Plugs with multiple sockets are available but the shorty extension cord provides much greater flexibility. It can be a permanent installation for that "tight" wall receptacle that will only accommodate two plugs, or for

the tool kit, however small. To make a "shorty," use a good end from any discarded lamp or appliance cord, attach a multiple receptacle a foot from the molded plug and it is ready for use.—*Glen F. Stillwell* R-E

**TV TUNER SERVICE**



VHF, UHF, FM or IF-Subchassis. . .  
. . . All Makes

*you get...*

**Fast 8 hr. Service!**

**1 YEAR GUARANTEE**



FIRST TO OFFER 365-DAY GUARANTEE!  
COLOR—BLACK & WHITE—TRANSISTOR TUNERS—  
ALL MAKES  
GUARANTEED COLOR ALIGNMENT—  
NO ADDITIONAL CHARGE

**You owe it to yourself**

to try P.T.S. We are the fastest growing, oldest and now the largest tuner service company in the world. Here is what you get.

1. Fastest Service—8 hr.—In and out the same day. Overnight transit to one of our six plants, for parts, tuners or IF-modules.
2. All tuners cleaned inside and out, repaired, realigned and air tested.
3. On IF-modules all stages checked, all traps set with high calibre test equipment.
4. Fine Quality! Your customers are satisfied and you are not bothered with returning your units for rework!
5. Lower Cost! Up to \$5.50 less than other tuner companies!
6. Friendly, helpful personalized service!

**LIKE TO DO IT YOURSELF?**

PTS makes all tuner parts available to you.  
Send one dollar (redeemable) for our TUNER REPLACEMENT GUIDE AND PARTS CATALOG

- 60 pages of top information
- Blow-up of all tuners
- Largest exact tuner replacement guide
- Antenna Coil Replacement Guide
- Multi-fit Replacement Tuner Shaft Guide

**We offer you finer, faster...**



VHF-UHF-FM \$ 9.95  
UV-COMBO \$16.95  
IF-MODULE \$12.50  
Major Parts charged at Net Price

*CUSTOMIZED REPLACEMENTS AVAILABLE FOR \$12.95 UP (NEW OR REBUILT)*

For fastest service, send faulty unit with tubes, shields and all broken parts to  
**PTS ELECTRONICS, INC.**

HOME OFFICE—  
SOUTHEAST—  
WEST COAST—  
EAST—  
SOUTHWEST—  
MOUNTAIN—

P.O. Box 272—Bloomington, Ind. 47401  
P.O. Box 6771—Jacksonville, Fla. 32205  
P.O. Box 41354—Sacramento, Calif. 95841  
P.O. Box 3189—Springfield, Mass. 01103  
P.O. Box 7332—Longview, Tex. 75601  
P.O. Box 4145—Denver, Colo. 80204

Tel. 812/824-9331  
Tel. 904/389-9952  
Tel. 916/482-6220  
Tel. 413/734-2737  
Tel. 214/753-4334  
Tel. 303/244-2818

Circle 85 on reader service card

# NEW

from  
endeco



The Pencil Soldering Iron with Operating Light, 2 Heats and On/Off Switch

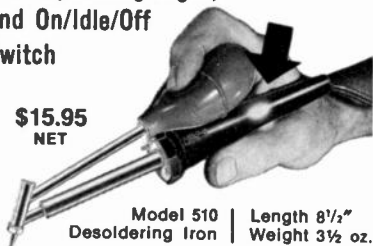


\$10.95  
NET

Model 540S  
Soldering Iron  
Length 8 1/2"  
Weight 2 oz.

- Light shows when it's on
- 2 heats—20w and 40w—for any job
- Ironclad tips for longer life
- Cool, unbreakable polycarbonate handle
- Burn-resistant neoprene cord
- Converts to a desoldering iron with low cost attachment

The Pencil Desoldering Iron with Operating Light, and On/Idle/Off Switch



\$15.95  
NET

Model 510 | Length 8 1/2"  
Desoldering Iron | Weight 3 1/2 oz.

- Light shows when it's on
- Operates at 40w; idles at 20w for longer tip life
- 6 tip sizes available to handle any job
- Cool, unbreakable polycarbonate handle
- Burn-resistant neoprene cord
- Exclusive new bracket insures alignment, prevents damage

New kits also available!

- Soldering Kits • Desoldering Kits
  - Soldering/Desoldering Kits
- See your distributor or write...



5127 EAST 65TH ST.  
INDIANAPOLIS,  
INDIANA 46220  
PHONE 317/251-1231

enterprise  
development  
corporation

## next month

APRIL 1973

### ■ Add-On Electronics For Your Car

A survey of the latest electronic devices you might want to add to your car. Everything from electronic ignition to windshield-wiper pause controls.

### ■ Build A Digital Tach For Your Dash

Compact easy-to-build unit tells you in numbers how many rpm your engine is turning over. Use IC's and digital readout tubes to speed construction.

### ■ Transistor Substitution Directory

This second part presents complete listings of about 250 transistor types and their replacements from eight suppliers.

### ■ Build A Liquid Crystal Clock

Use COSMOS IC's, a 4-digit liquid-crystal display and a printed-circuit board to build a battery-powered crystal-controlled clock

PLUS:

State-Of-Solid State

TV Service Clinic

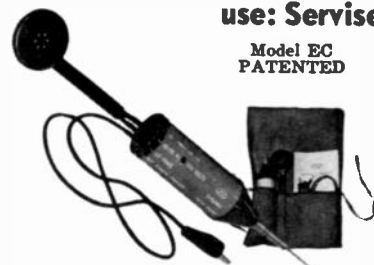
Step-By-Step Troubleshooting

Measuring dB With your Scope

## To Troubleshoot FAST & EASY

use: Serviset

Model EC  
PATENTED



\$34.95

Postpaid  
COD

FREE  
INFORMATION

Now available at all Olson stores.

CHECKS: sync, sweep, video, audio circuits, high voltage supplies (DC, RF or Pulse), low voltage supplies, coils, capacitors, resistors, tubes, transistors, diodes, transformers, speakers, etc. Will locate trouble to a particular stage, determine defective component and can actually be clamped in circuit to restore circuit operation temporarily in 80% of component or tube defects. Ideal for locating and confirming intermittents.

SPECIFICATIONS:

RF & AF Signal Tracer, RF & AF Signal Injector, AC & DC Voltage Indicator 0/60/550/20,000 DC Polarity Indicator 60/550/20,000 volts, Lo ohms 0-5. Hi ohms 0-500k-20 megohms. Tests Condensers, .00025-12 mfd., Tests Resistors 2 ohms-20 megohms, 2 Capacitance Sub ranges .01-.1 & 4-40 mfd., 3 Resistance Sub ranges 50-500 ohms, 5k-25k, 100k-1 meg.

## NEW CT-1

From

Will allow you  
to Dynamically test all  
types of capacitors.



The Model CT-1 features a built-in electronic power supply providing BOTH AC and DC Test Voltages in a special circuit with highly sensitive NEON type leakage indicator. The CT-1 permits quick, accurate testing of condensers for leakage or shorts with actual DC voltage applied and readily indicates intermittent OPEN condensers with AC applied. Self-regulating power supply circuit provides tapered forming current to suit particular requirements of capacitor under test. Special circuit re-forms and polarizes electrolytic and tantalum capacitors under test. High sensitivity permits determination of condenser dielectric breakdown before leakage causes major shut-down.

Only \$16.95 postpaid

Capacitor Range: .00025 — 1000 mfd.  
Sensitivity: Over 200 MEGOHMS

80 DAY MONEY-BACK GUARANTEE

LEE ELECTRONIC LABS., CO.



88 Evans Street  
Watertown, Massachusetts 02172

Dealer Inquires invited

# IMPOSSIBLE? BARGAINS IN SURPLUS ELECTRONICS AND OPTICS

## NEW - COSMOS INTEGRATED CIRCUIT

Said to be the "New Wave" in integrated circuits of the future. Ultra low power drain (microwatts)

<input type="checkbox"/>	4000AE	Dual 3 Input Nor & Inv	\$ .99
<input type="checkbox"/>	4001AE	Quad 2 Input Nor	\$ .99
<input type="checkbox"/>	4002AE	Dual 4 Input Nor	\$ .99
<input type="checkbox"/>	4006AE	18 Stage Static Shift Register	\$4.99
<input type="checkbox"/>	4007AE	Dual Complementary Pair & Inv	\$ .99
<input type="checkbox"/>	4009AE	Hex Buffer, Inverting	\$2.19
<input type="checkbox"/>	4010AE	Hex Buffer Non Inverting	\$2.19
<input type="checkbox"/>	4011AE	Quad 2 Input Nand	\$ .99
<input type="checkbox"/>	4012AE	Dual 4 Input Nand	\$ .99
<input type="checkbox"/>	4013AE	Dual "D" Flip Flop	\$1.99
<input type="checkbox"/>	4014AE	8 Stage Static Shift Register	\$5.99
<input type="checkbox"/>	4015AE	Dual 4 Stage Static Shift Register	\$5.99
<input type="checkbox"/>	4016AE	Quad Bilateral Switch	\$1.99
<input type="checkbox"/>	4017AE	Decade Counter W/Decoder	\$5.99
<input type="checkbox"/>	4018AE	Presetable Divide by "N" Counter	\$5.99
<input type="checkbox"/>	4019AE	Quad and/or Select Gate	\$2.39
<input type="checkbox"/>	4020AE	14 Stage Binary Ripple Counter	\$5.99
<input type="checkbox"/>	4021AE	8 Stage Static Shift Register	\$5.49
<input type="checkbox"/>	4022AE	Octal Counter W/Decoder	\$5.19
<input type="checkbox"/>	4023AE	Triple 3 Input Nand	\$ .99
<input type="checkbox"/>	4024AE	7 Stage Counter	\$3.99
<input type="checkbox"/>	4025AE	Triple 3 Input Nor	\$ .99
<input type="checkbox"/>	4026AE	Decade Counter/7 Segment Decoder	\$7.49
<input type="checkbox"/>	4027AE	Dual J-K Flip Flop	\$2.99
<input type="checkbox"/>	4029AE	Presetable Up/Down Counter	\$7.99
<input type="checkbox"/>	4030AE	Quad Exclusive Or	\$1.99
<input type="checkbox"/>	4033AE	Decade Counter/7 Segment Decoder	\$7.49

## SPECTRA - STRIP FLAT BONDED



We know this is what everyone wants for their home-brew projects, because they always ask for it. We now have over 5 by 10' feet, but it won't last long, so order now before it's all gone. We don't want any broken hearts. Specs: 20 conductors, 24 AWG, 7 strands, size is .88" x .044". We could give all its virtues, but most people know them or could easily look it up in any industrial electronics house catalogue.

Sh. Wt. 1lb./10 feet . . . . . Order No. SSFBC (ft.)  
 \$ .35/1 ft.  \$ 1.00/3 ft.  \$ 5.00/18 ft.  
 \$30.00/100 ft.  \$5.00/200 ft.  \$100.00/400 ft.  
 \$200.00/900 ft.  \$500.00/2000 ft.

## SANKEN HYBRID AUDIO AMPLIFIER MODULES

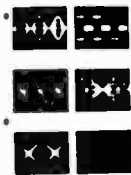


We have made a fortunate purchase of Sanken Audio Amplifier Hybrid Modules. With these you can build your own audio amplifiers at less than the price of discrete components. Just add a power supply, and a chassis to act as a heat sink. Brand new units, in original boxes, guaranteed by B and F, Sanken, and the Sanken U.S. distributor.

Available in three sizes: 10 watts RMS (20 watts music power), 25 watts RMS (50 watts M.P.), and 50 watts RMS (100 watts M.P.) per channel. Twenty-page manufacturer's instruction book included. Sanken amplifiers have proved so simple and reliable that they are being used for industrial applications, such as servo amplifiers & wide band laboratory application.

<input type="checkbox"/>	SI1010Y	10 watts RMS amplifier, industrial grade	\$ 4.75
<input type="checkbox"/>	SI1025A	25 watt RMS amplifier, industrial grade	\$14.75
<input type="checkbox"/>	SI1050A	50 watt RMS amplifier, industrial grade	\$22.50
<input type="checkbox"/>	SI1025E	25 watt RMS amplifier, economy grade	\$14.00
<input type="checkbox"/>	SI1050E	50 watt RMS amplifier, economy grade	\$21.00
<input type="checkbox"/>		Transformer for stereo 10-watt amplifiers (2 lbs.)	\$ 3.95
<input type="checkbox"/>		Transformer for stereo 25 or 50 watt amplifiers (5 lbs.)	\$ 5.95
<input type="checkbox"/>		Set of (3) 2000 mfd 50V capacitors for 10-watt stereo	\$ 4.00
<input type="checkbox"/>		Set of (3) 2200 mfd 75V capacitors for 25 or 50 watt amplifiers	\$ 5.00
<input type="checkbox"/>		4 Amp Bridge Rectifier, suitable for all amplifiers	\$ 2.00
<input type="checkbox"/>		Complete kit for 100 watt RMS stereo amplifier (200 watt music) including two 50-watt Sanken hybrids, all parts, instructions, and nice 1/16" thick, black anodized and punched chassis	\$88.00
<input type="checkbox"/>		Same for 50 watt RMS stereo amplifier, includes two 25 watt Sankens, etc.	\$58.00
<input type="checkbox"/>		Same for 20 watt RMS stereo, includes two 10 watt Sankens, etc.	\$30.00

## WAVEFORM GENERATOR, BF-5



Just one of these BF-5 devices produces sine, square, triangle, ramp and sawtooth waveforms without additional active components. By adding a second BF-5, you can create amplitude, frequency or phase modulated varieties of these waveforms. They are able to replace large discrete waveform generators costing from \$200.00 to \$1300.00. At the same time, they

greatly reduce system weight and power consumption. Full technical data, P.C. layout, assembly, and hook-up instructions included.

BF-5 WAVEFORM GENERATOR . . . . \$ 9.75

## WIRE-WRAP COMPUTER WIRE



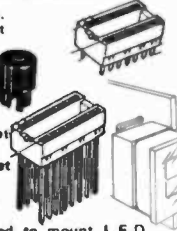
New surplus from a large computer company. Solid silver-plated OFHC copper conductor. Special high-temperature, thin-wall insulation of teflon, and other quality materials. Extremely rugged and flexible wire-wrap wire. In addition to usual applications, can be used for effective breadboarding, and wherever quick stripping of solid wire is desired. Different colors are now available. State first, second, and third choice of colors. Shipping weight per 500' is 1 lb.

Conductor	Order No.	500'	1000'	10,000'
Size				
30	WWW30(ft.)	\$5.00	\$9.00	\$75.00
26	WWW26(ft.)	\$6.00	\$11.00	\$95.00
24	WWW24(ft.)	\$6.50	\$12.00	\$100.00

## SUPER QUALITY I.C. SOCKETS

Sockets made by T.I. and Cinch. All are low-profile, compact types.

14 Pin Dip Solder Tail Sockets	3 for \$1.25	16 for \$5.00
16 Pin Dip Solder Tail Sockets	2 for \$1.00	13 for \$5.00
14 Pin Dip Gold Wire Wrap Sockets	2 for \$1.25	10 for \$5.00
16 Pin Dip Gold Wire Wrap Sockets	2 for \$1.50	8 for \$5.00
10 Pin to 5 Gold Sockets (Cinch)	2 for \$1.00	13 for \$5.00
14 Pin Right Angle Socket. Used to mount L.E.D. displays directly to P.C. board at correct viewing angle		\$1.00



## SINGLE CHIP 7-SEGMENT DISPLAY COUNTER, AND DECODER.



That's right! A single chip TTL decade counter with latches, BCD outputs, a 7-segment decoder driver, AND a 7-segment LED display (with decimal) on top. Only 0.15" thick (not counting pins), the chip mounts in a standard 16-pin DIP socket. Digits are 0.270" high and can be latched in during the next count or blanked.

0.27 DLO . . . . . \$15.00

## 70 WATT RMS AUDIO AMPLIFIER BASIC PACKAGE, STEREO \$5.50



Take advantage of Signetic's NE540 power driver, (class AB amp). Designed for 35 watts RMS per channel. Distortion .5% frequency response,  $\pm$  5db 20Hz to 100 Hz. NE540 requires two power transistors, a 2N5296 (NPN) and a 2N6109 (PNP), supplied per NE540. Kit package includes (2) NE540, (2) 2N5296, (2) 2N6109, information on P.C. board layout, parts and circuitry, and a list of miscellaneous small parts required to build the 70 watt amplifier for stereo.

<input type="checkbox"/>	NE540	\$2.25/ea.
<input type="checkbox"/>	2N5296 35 watt NPN	.75/ea.
<input type="checkbox"/>	2N6109 40 watt PNP	.75/ea.
<input type="checkbox"/>	70 watt Stereo Kit	\$5.50/ea.
<input type="checkbox"/>	35 watt Mono Kit	\$2.95/ea.

## FAIRCHILD VOLTAGE REGULATORS



This is the UA 7800 Series. Three terminal regulator, with thermal overload protection and internal current limiting, making it essentially blow-out proof. Because simple circuitry is used with this device, designing regulated power supplies is duck soup. Output is rated at 0 to 1 ampere; maximum input voltage is 35 volts. Choice of voltages: 5, 6, 8, 12, 15, 18, or 24 Volts. Order as 7805, 7806, 7808, etc.

Voltage Regulator (Specify Voltage) . . . . \$2.00

## PRINTED CIRCUIT MATERIAL

Epoxy glass G10 material. Specify single or double copper clad. Thickness 1/16 inch.

<input type="checkbox"/>	4 x 12 Sheets	\$1.00, 5 for \$ 3.50
<input type="checkbox"/>	12 x 12 Sheets	\$2.50, 5 for \$10.00
<input type="checkbox"/>	Assorted cut pieces at least 4" x 4" 2 square feet	\$2.50

## COMPACT BRIDGE



2 Amp	200 Volt	\$ .60
2 Amp	400 Volt	\$1.00
2 Amp	600 Volt	\$1.50
2 Amp	800 Volt	\$2.00
2 Amp	1000 Volt	\$2.50
4 Amp	400 Volt	\$1.50
4 Amp	600 Volt	\$2.00
4 Amp	800 Volt	\$2.50



SHRINK TUBING. B and F has a truckload of shrink tubing, but we still expect it to go fast. If you have ever used shrink, you know it is indispensable for electronic construction.

Made a wire too short? Just splice and shrink tubing over it and it will look like new. Pins too close? Same solution. Excellent results with hot-air gun, soldering iron, or even a match. This is polyolefin type where outer wall shrinks, inner wall melts to encapsulate wire.

SHRINK TUBING ASSORTMENT, 25 feet each, of 1/8, 3/16, 1/4-inch tubing . . . . . \$5.00

## SPECIAL I.C.'S, PHASE LOCKED LOOPS

<input type="checkbox"/>	NE560 Phase Locked Loop	\$4.65
<input type="checkbox"/>	NE561 Phase Locked Loop	\$4.65
<input type="checkbox"/>	NE562 Phase Locked Loop	\$4.65
<input type="checkbox"/>	NE565 Phase Locked Loop	\$4.65
<input type="checkbox"/>	NE566 Function Generator/Tone Encoder	\$4.65
<input type="checkbox"/>	NE567 PLL/Tone Decoder	\$4.65
<input type="checkbox"/>	NE595 Four Quadrant Multiplier	\$3.75
<input type="checkbox"/>	NE555 Timer, 2u Sec to 1 hour, Special	\$1.25

## CATALOG. Check reader's card or write.

ALL ITEMS (WHERE WEIGHT IS NOT SPECIFIED) POSTAGE PAID IN THE U. S. A.

CHARGES WELCOME!

Phone in charges to 617 531-6774 or 617 532-2223. BankAmericard - Mastercard. \$10.00 minimum. No C.O.D.'s please.



\$10.00 MINIMUM CHARGE



## B. & F. ENTERPRISES

Phone (617) 532-2223  
 P.O. Box 44, Haverhill, Massachusetts 01937

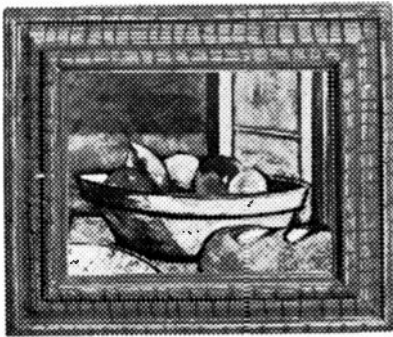
## 64 CHARACTER ASCII CODE ALPHANUMERIC L.E.D. DISPLAY



This display consists of 35 L.E.D.'s (light emitting diodes) arranged in a 5 x 7 matrix. Numbers and letters of the alphabet can be formed by lighting the appropriate segments, i.e. from our 2513 character generator Rom. One 2513 can be used to drive up to 64 displays by time sharing. In

<input type="checkbox"/>	14 Pin Dip Package.	
<input type="checkbox"/>	64 Character 5 x 7 LED Display	\$ 9.75
<input type="checkbox"/>	2513 Character Generator Rom	\$12.00

# POLY-PLANAR IS HI-FI SOUND IN ART.



Lets you turn on a painting, your favorite photo, a mirror, a bookend. Lets you decorate your home with sound. Send for detailed specifications and installation ideas.

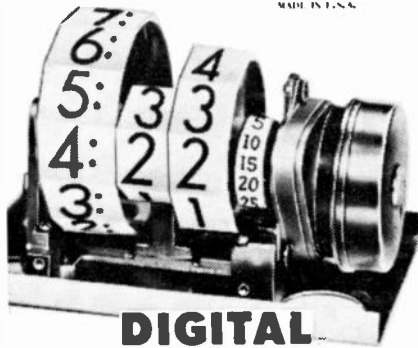
## THE SPEAKER YOU DON'T HAVE TO SEE TO HEAR.

**The Magitran Company**

311 East Park Street • Moonachie, New Jersey 07074

Circle 89 on reader service card

**TYMETER**  
"Time At A Glance"  
DIGITAL CLOCKS  
Since 1935  
9:37  
MADE IN U.S.A.



## DIGITAL CLOCK MOVEMENTS

#130...12 HOUR #131...24 HOUR  
DIGITS RESETTABLE INDIVIDUALLY

Available in 50, 60 cy., all voltages, AC. UL approved motor, cord. One Year Guarantee.

Tymeter #90  
Direct Read-  
Out Interval  
TIMER

by seconds,  
minutes, 1/4 hr.,  
1/2 hr., hour



Complete Line of Count-Up and  
Count-Down Digital Computers

CATALOG ON REQUEST

**PENNWOOD NUMECHRON CO.**

TYMETER ELECTRONICS  
DIVISION OF LCA CORPORATION  
7249 FRANKSTOWN AVE., PITTSBURGH, PA. 15208

Circle 90 on reader service card

## APPLIANCE CLINIC (continued from page 32)

that both sides are in good shape.

The timer-drive motor is a small sealed synchronous unit, a lot like those used in electric clocks. A gear-train is used to give the little motor enough torque to drive the cam assembly. We find very little trouble with these motors, although if the machine has been visited by lightning, the winding may be open. Normally, neither the motor or gear train will require lubrication.

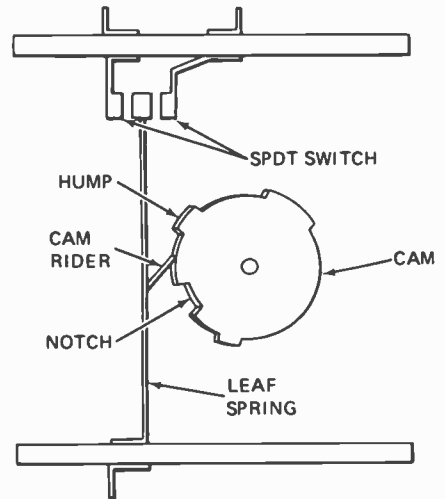


FIG. 2—CAM DRIVES CONTACT ARMS in timer, as shown here.

# START THE NEW YEAR WITH A GREAT BARGAIN!

GET THESE TWO TV TECH AID BOOKS AT  
REDUCED PRICES:

1971 B&W BOOK — NOW \$4.95

1970-BOOK FORM — NOW \$4.95

TV TECH AID BOOKS ARE FILLED WITH THE LATEST QUICK-SERVICING  
INFO ON COLOR TV, B&W TV, AND STEREO

TV Tech Aid Takes you right to the source of the trouble without guess work and wasted time. In each monthly issue you receive over 40 actual causes and cures of color and B&W TV trouble symptoms. You also receive timely and complete information about circuit modifications and other valuable service data.

USE THE COUPON BELOW TO PLACE YOUR 1973  
SUBSCRIPTION (12 ISSUES \$7.95) OR VALUABLE BACK ISSUES

SEND YOUR CHECK  
OR MONEY ORDER  
TO:

**TV TECH AID**

P. O. Box 603  
Kings Park  
N.Y. 11754

- 1969 12 Issues \$4.95     1970-Book Form \$4.95  
 1971 B&W Book \$4.95     1971 12 Issues \$5.95  
 1972 12 Issues \$7.95     1973 All New 12 Issues \$7.95

Name.....

Address.....

City.....

State.....Zip.....

Circle 91 on reader service card

This type of motor isn't repairable; the whole motor must be replaced. In most units, this can be done without even taking the timer off. Take out two or three screws and it drops off into your hand. Exact duplicate replacements must be used, of course. These are available from the distributor for this make of appliance, or from independent parts-wholesalers.

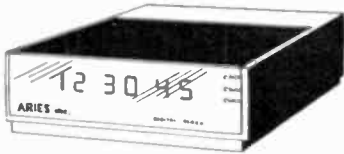
As I said, we have very few troubles with motors like this. When we do though, it's sometimes a dandy. In one notable case, an air-conditioning system had a very puzzling intermittent. Most of the time it worked perfectly. Once in a while, it would start, then shut down. After much head-scratching, and some not-too-nice language, we "caught it in the act". These tiny motors are synchronous and they always start in the same direction. This one had to start a timer, and run through a couple of operations, so that the system could start cooling properly.

While watching it on start-up, we finally saw what it was doing. It was running *backward*.

We haven't figured out exactly *what* went wrong inside the little monster, but I still have it on my desk. R-E



# ARIES



## NEW FROM ARIES! ULTRA LOW COST DIGITAL CLOCK (STANDARD TIME CHRONOMETER)

Aries/BF has sold over 12,000 digital clocks, to the best of our knowledge more than the combined output of all other manufacturers. Because of our huge purchasing power, and the engineering background gained, we can offer the features listed below. Compare with any other manufacturer and see if they can offer all these features:

- Decorator solid walnut case. A Striking addition to even the most luxurious living room. Our sketches just don't do it justice.
- Superb accuracy, seconds per month
- Choice of 50 or 60 Hz operation, 12 or 24 hour display in hours, minutes, seconds
- BCD outputs, for auxiliary readouts etc.
- Excellent beginners kit, elaborate step by step instructions debugged by trial construction by experimenters who have never built a kit before. Only a soldering iron, wire snip and screwdriver needed. Guaranteed success (maximum repair charge \$10.00)

Low-cost Digital Clock Kit..... \$47.50

### OPTIONS

- 00 - Standard readouts, GE florescent standard unless otherwise specified. Cool blue green color, best for decor of living rooms, bedrooms etc., this is the unit that draws Oh's and Ah's.
- 01 - Burroughs 85750 nixie tube readout instead of GE hot orange color. Looks at home in a lab. No extra charge.
- 02 - Man 1 L.E.D. readouts. Intense red, monochromatic light output, laboratory environment type display. Add \$22.50 additional for this display.
- 03 - Quartz crystal time standard. In most environments standard line operated units will give accuracy of a second a month. If you live in an area where line frequency is poor, this will give you an independent time base of .0005% accuracy when properly trimmed. Add \$22.50 for this crystal time base.
- Special - National MM5311 clock chip and readouts only, with instructions for do it yourself clock projects. Specify GE florescent or Burroughs 85750 nixie tubes as readouts ..... \$24.50

## TEXAS INSTRUMENTS "ELECTRONIC SLIDE RULE" CALCULATOR



This brand new calculator from T.I. promises to revolutionize engineering calculations! Use scientific notation, i.e., 4235.7867 is expressed as  $4.2357867 \times 10^3$ . Does squares, square roots, reciprocals, adds, subtracts, multiplies, divides. If you have been looking at electronic slide rules

you know what a phenomenal deal this is. By the way this is direct entry as opposed to HP's indirect entry.

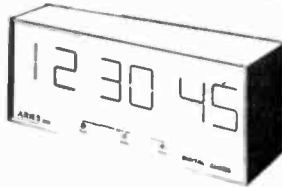
T.I. "Electronic Slide Rule" ..... \$149.00



## FUNCTION GENERATOR KIT IMPOSSIBLE?

A \$700.00 function generator for \$99.00? But true! The new, low-cost EXAR-205 monolithic waveform generator makes this price possible. Our kit uses two generator circuits - one is a carrier generator, and produces sine, triangle, square, sawtooth, ramp and pulse waveforms. The second is a modulation generator, for amplitude or frequency modulation of the output waveforms. Output frequency range is from 20 Hz to 1.5 megahertz. Modulation is switch-selectable for internal AM, internal FM, or external modulation.

Model AR-620K Function Generator ... \$99.00



## GIANT 2 1/2" NUMERAL "NIXIE" CLOCK KIT

New! For factories, offices, and commercial establishments, and those people who like large displays, characters appear as a bright continuous line which can be read from distances as great as 150 feet. All drive circuits are solid state, and unit employs new custom LSI clock chip. Indicates hour, minutes, and seconds. May be wired for 24 hour or 12 hour operation with a simple jumper change. Kit offered complete with or without case for custom installations. Parts include P.C. board, sockets, solid state components, hardware, resistors, caps, viewing filter, etc.

Sh. Wt. 15 lbs.

- GNCC/C With Case ..... \$98.50
- GNCC Without Case ..... \$84.50

## VIEW HOLOGRAMS! PERFORM OTHER EXCITING EXPERIMENTS LASER KIT!



Now available only from Aries! Brand new Hughes "Hip Pocket" type tube, and Aries power supply kit, plus complete experimental accessories. These tubes are completely guaranteed by Aries and

Hughes, but are available at this bargain price because their power output is slightly below Hughes standard. Because of this fortunate purchase, you can purchase the complete experimental kit for less than the price of the tube alone. The Hughes specification for this tube is 1.4 milliwatts output power when new, so that minimum power specification of 1 milliwatt can be met throughout life of tube. Our specification is initial power between 0.9 and 1.4 milliwatts, guaranteed not to go below 0.5 milliwatt during the guarantee period (6 months continuous operation!) Our kit includes experimental accessories such as lenses, pinholes, mirrors and a hologram to perform hundreds of fascinating experiments. Holograms viewing is easily demonstrated with this kit, hologram making is possible, but is recommended only for advanced experimenters.

Laser Experimental Kit ..... \$119.00



## AIRCRAFT/AUTO/BOAT QUARTZ CRYSTAL CHRONOMETER

Revolutionary!, was the reaction of our customers when they saw our latest kit. Measuring only 2 1/2" x 2 3/8", and accurate to 10 seconds a month, this chronometer promises to entirely replace mechanical clocks in cars, boats and airplanes.

Fits into a standard 2 1/4" instrument panel cutout. The displays are bright L.E.D. displays that should last a lifetime. Setting controls are recessed and operate from a pointed object such as a pencil point or paper clip, in order to keep non-authorized hands off. The clock should only have to be reset at very great intervals, or in the event of power loss (i.e. replacing battery in car). The clock is wired so that the timing circuits are always running, but the displays are only lit when the ignition is on, resulting in negligible power drain. The low price is only possible because of a new one chip MOS clock circuit, developed for quartz crystal wristwatches.

Operates from 10-14 Volts D.C. An accessory unit which mounts on the back adapts the unit 59 20-28 volts for twin engine aircraft and larger boats using 24 Volts ignition. Know how disgusted you are with the usual car clock? Order this fine unit now for rallying, sports events, navigation, or just to have a fine chronometer that will give you a lifetime of superbly accurate time.

- Quartz Chronometer, Kit Form..... \$69.50
- Quartz Chronometer, Wired ..... \$99.50
- 24 Volt Adapter ..... \$10.00



## 50 MHz DIGITAL COUNTER LABORATORY SPECIFICATIONS AT A BUDGET PRICE!

We feel the most important thing about building a kit is saving money. There are a lot of other advantages of course . . . maintainability, use of standard parts, complete documentation, and the experience and fun of building it, but the overriding consideration is economy. This kit costs less than half that of the lowest priced competitive unit on the market.

The Aries 50 MHz counter is designed for years of maintenance free service. MSI integrated circuitry, cold cathode display tubes and conservatively rated transformers mean low temperature rise. All displays and I.C.'s are in sockets for easy maintainability. The master oscillator is a 1.0 MHz crystal in a custom designed cosmo oscillator circuit, having a stability of  $\pm 3$  PPM. Accuracy is 0.005% worst case, 0.0002% or better when adjusted to WWV with a communications receiver. A front panel selects a timing interval of 1.0 seconds, 0.1 seconds or 10 milliseconds. A variable monostable multivibrator holds the count on the front panel for a period of a fraction of a second to infinity. For use in the period mode, the 1.0 MHz oscillator is connected to the main counting chain and gated by the input signal.

Assembly time for the kit is approx. 10 hours. The semiconductor complement is (1) 7400, (1) 7408, (1) 7442, (1Q) 7490, (2) 74122, (6) 74141, (1) 74193, (1) 74196, (1) 74S11, (1) CD 4007AE, (1) LM309, (6) Diodes, and (1) Transistor. If you always wanted a laboratory quality counter, but could never justify the price, here is your chance.

50 MHz Counter Kit, Complete with Crystal Time Base and Case - Postpaid in USA . . . \$126.50



## POCKET CALCULATOR

We expected a favorable reaction to our calculator, however, we were overwhelmed when we received orders for hundreds at a time. The reaction of our customers was that they felt this was the most advanced pocket calculator on the market, and priced so low, they could assemble and market it at a profit. The features that make this so exciting are:

- So compact it fits in a shirt pocket (3-13/16 x 4-5/8 x 1-1/4).
- Performs every function you would expect in a desk calculator, and then some, multiplies, divides, adds, subtracts and gives true credit balance. Includes constant and chain operation, full floating decimal, suppressed trailing zeroes, and automatic single entry squaring.
- Powered by self contained AA batteries with up to six hours operation (Nicaid batteries with charger option, up to five hours per charge).
- Calculations performed by a single 40 pin LSI (large scale integration) chip. Displays are 8 digit LED's (light emitting diodes) and overflow and minus signs are also LED's.

As a student, engineer, salesman, accountant or anyone who would like fast accurate answers, this calculator fills the bill, and at a price that unquestionably makes this the lowest price high quality calculator available.

- Pocket Calculator Kit ..... \$75.00
- Pocket Calculator Completed ..... \$99.00
- NiCad Batteries & Charger ..... \$17.50
- Batteries & Charger Completed ..... \$25.00

Check Enclosed  Master Charge  BankAmericard

Charge No.

ARIES, Inc.  
119 Foster Street, Peabody, Mass. 01960  
(617) 532-0450

## MAN LED

- High brightness--350ft-L
- RCOs
- single plane, wide angle viewing--150°
- standard 14 DIP
- long life--solid state
- operates with IC voltage requirements
- displays all digits and 9 distinct letters



\$425 EACH

- schottky TTL \$3.00 EACH**
- 82530 8 input multiplexer
  - 82533 2 input 4 bit multiplexer
  - 82541 quad E/OR element
  - 82542 4 bit comparator
  - 82562 9 bit parity gen./checker
  - 82567 2 input 4 bit multiplexer

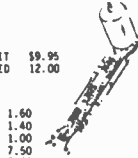
## CD3 universal counter

Can be programmed to count to any modulus 2-9 for one kit, 2-99 for two kits, etc. Includes board, 7490, 7447, RCA DR2010 humitron display tube and five programming components. Full instructions included - perfect for displaying seconds, minutes and hours, etc.



## CD2 digital counter

Unit includes board, 7490, 7475 quad latch, 7447 seven segment driver, and RCA DR2010



## 8000 series TTL DIP

- 82100 4 bit comparator 1.60
- 82110 8 line to 1 line selector 1.40
- 82200 parity gen/checker 1.00
- 82223 256 bit programmable ROM 7.50
- 82300 8 input multiplexer 2.00
- 82323 2 input 4 bit multiplexer 1.75
- 8242 4 bit comparator 1.00
- 8251 BCD to decimal decoder 1.00
- 8261 fast carry extender 2.00
- 8266 2 input 4 bit multiplexer 1.50
- 8270 4 bit PI, SI, PO, SO 2.00
- 8271 4 bit shift register 2.00
- 8273 10 bit SI, PO register 3.00
- 8274 10 bit PI, SO register 3.00
- 8280 45Kc presetable decade counter 1.15
- 8281 45Kc presetable binary counter 1.15
- 8290 presetable dec. counter 75Mc 3.50
- 8292 presetable dec. counter 10Mc .90
- 8520 25Mc divide by "N" 2 to 15 2.00
- 8561 tri state quad latch 2.00
- 8570 8 bit SI, PO 1.50
- 8690 8 bit PI, SO 1.50
- 8275 quad bistable latch .90
- 748 op amp 105 1.50
- NE555 prec. timer MINI 1.25
- CA3065 TV/FM sound sy. tm DIP .75

## 7400 series DIP

7400	.25	74H11	.50	7451	.25	74H74	.85
74L00	.35	7413	1.75	74L51	.35	7475	1.15
74H00	.35	7420	.25	74H51	.35	7476	.55
7401	.25	74L20	.35	74L52	.40	74L78	1.00
74H01	.35	74H20	.35	7453	.25	7480	.50
7402	.25	74H22	.50	74H53	.40	7483	1.15
7403	.25	7430	.25	7454	.30	7486	.65
7404	.25	74L30	.35	74L54	.35	7489	3.00
74L04	.35	7440	.25	74L55	.35	7490	1.00
74H04	.35	74H40	.40	7460	.25	7491	1.15
7405	.25	7441	1.30	74L71	.50	7492	.90
74H05	.35	7442	1.00	7472	.40	7493	.90
7406	1.00	7446	1.50	74L72	.40	7495	1.15
7408	.40	7447	1.50	7473	.55	74L95	2.00
74H08	.50	7448	1.25	74L73	.80	74L07	.55
7410	.25	7450	.25	7474	.40	74L53	1.75
74L10	.35	74H50	.40	74L74	.80	74L92	2.25
						74L93	2.00
						74L95	1.00

all ICs shipped within 24hrs.

## linears

- LM100 positive DC regulator TO-5 .80
- NE520 high speed comparator DIP 1.00
- NE560 phase lock loop DIP 3.25
- NE561 phase lock loop DIP 3.25
- NE565 phase lock loop TO-5 or MINI 3.25
- NE566 function generator TO-5 or MINI 3.50
- NE567 tone decoder TO-5 or MINI 3.50
- 709 popular op amp DIP .35
- 710 voltage comparator DIP .50
- 711 dual comparator DIP .75
- precision voltage reg. DIP 1.00
- 555B dual 741 op amp MINI 1.00
- 810 dual op amp DIP .80
- 747 dual 741 op amp DIP 1.00
- LM302 op amp voltage follower TO-5 1.25
- LM308 op amp TO-5 2.00
- LM311 comparator TO-5 1.50
- LM380 2W audio amp DIP 1.50
- LM703 RF-IF amp approx TO-5 .80
- LM3059 Si-A power supply module TO-3 2.50
- LM309H Si-200mA power supply TO-5 1.00

## calculator on a chip

40pin DIP  
Add, subtract, multiply, and divide  
12 digit display and calculate  
Chain calculations  
True credit balance sign output  
Automatic overflow indication  
Fixed decimal point at 0, 2, 3, or 4  
Leading zero suppression  
Complete data supplied with chip



\$9.95

SILICON signal diodes  
100 PIV - 80 ma  
60 for \$2.50

## RCA 2010

- digital display tube
  - incandescent SV
  - 7 segment
  - .6" high numeral
  - visible at 30 feet
  - soft hand decimal
  - 9 pin base (solderable)
- EACH \$ 5.00  
5 FOR 20.00

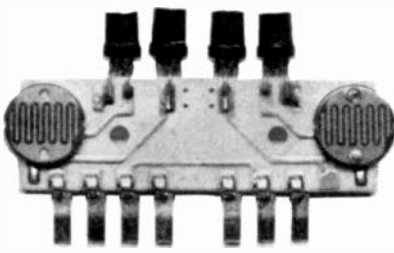
All IC's are new and fully tested - leads are placed with gold or solder. Orders for 55 or more will be shipped prepaid. Add 35¢ handling and postage for smaller orders. California residents add sales tax. IC orders are shipped within two workdays of receipt of order - kits are shipped within ten days of receipt of order. MONEY BACK GUARANTEE ON ALL GOODS SOLD. .... COD's may be phoned in.

## BABYLON ELECTRONICS

P.O. BOX J, CARBONDALE, CALIF. 95608 (951) 966-2111

Circle 93 on reader service card

## DUAL PHOTO CELL ASSEMBLY



Actual size

2 separate G.E. photo-cells and 2 stage NPN transistor amplifiers. Entire unit on ceramic base, complete. Circuit diagram and application data included.

STOCK NO. J5050  
\$1.25 ea. 5/5.00

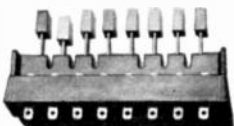
## POWER TRANSFORMERS FOR SEMICONDUCTOR PROJECTS

- 22 volts @ 0.5 amp. 2"x1 1/2"x1 1/2" J9451 1.75 ea. 4/6.00
- 48 volts ct. @ .5 amp & 5.5 volts @ 0.5 amp. 2 1/2"x2 1/2"x2" J9450 2 lbs. \$2.50 ea. 4/9.00
- 12 volt, ct. @ 4.0 amp. & NIXIE winding, 170 volts @ 150 ma. J9449 2 1/2"x3"x2 1/2". 3 lbs. \$3.50 ea. 4/13.00
- 34 volts, ct. @ 5.0 amp. & 5 volts @ 1.5 amp. 3 1/2"x3 1/2"x2 1/2". J9448 5 lbs. \$4.75 ea. 2/9.00

## 8 SECTION PUSHBUTTON SWITCHES

New lot of G.E. 8 section push button switches, each switch SPST, and rated 8 amps at 240 volts. Each push button is a different color for positive identification. 4 1/2"x1 1/2"x2 1/2". Pushing any switch releases any switch that is already closed.

STOCK NO. J9052 1.25 ea. 5/5.00



Include sufficient postage, excess will be refunded. Send for new 48 page catalog loaded with other items. Minimum order \$3.00

**DELTA ELECTRONICS CO.**  
BOX 1, LYNN, MASSACHUSETTS 01903  
Phone (617) 388-4705

Circle 94 on reader service card

# circuits

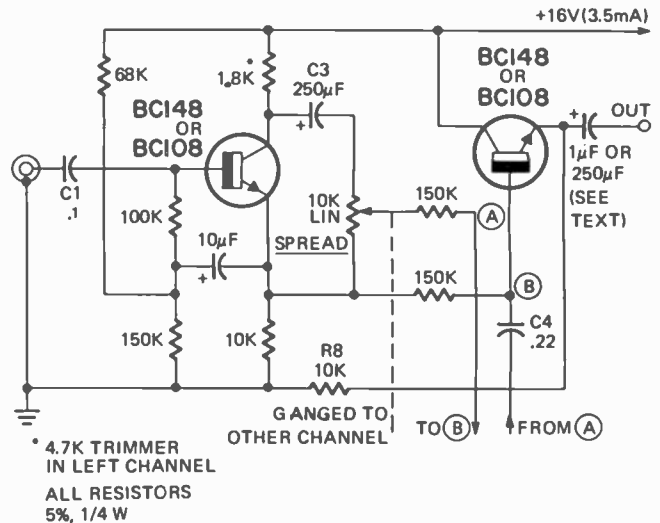
## STEREO WIDTH CONTROL

If you are sometimes bothered by insufficient spread from some stereo material, this simple device (Mullard's *Sound-Source Width Control*) may be the answer. The diagram shows the circuit of one of the two almost identical channels. (In one channel the input collector load resistor is a preset 4700-ohm trimmer resistor.)

Circuit gain is 0.5, input impedance is 750,000 ohms, output impedance 47,000 ohms and response is 20 Hz to 20,000 kHz at 3-dB points. Total distortion is less than 0.1% for 0.5 volt output and about 0.15% for 1.0 volt out.

The output blocking capacitor can be 1 μF when working into a load of at least 10,000 ohms. For lower load impedances, use a 250-μF blocking capacitor.

The sound-source width control is connected in the



stereo signal path where the signal level is 0.25 to 1.0 volt as between preamp and main amplifier, between tape output and tape-monitor jacks, or between two tape recorders. A 4-pole double-throw switch can be used to take the width control out of operation or you can simply mark the position of the SPREAD control where the normal stereo affect is not affected. Here is how it's done:

- 1—Connect the device to a stereo system.
- 2—Disconnect the right-channel output from the main amplifier or replace the right speaker with a dummy load.
- 3—Feed a signal into the right channel only and turn up the volume control until you hear a reasonably loud signal from the left channel.
- 4—Adjust the SPREAD control for minimum volume from the left speaker. Mark this position and make sure that the control setting is not changed any more.
- 5—Turn off the sound source. Connect the right channel and disconnect the left channel.
- 6—Feed a signal into the left channel and turn up the volume for a moderate signal from the right speaker.
- 7—Adjust the 4700-ohm trimmer for minimum output.

This completes the set-up operation. The SPREAD control now gives a mono effect at one end of its range, ordinary stereo in the "null" position located in Step 4 and extra-wide stereo at the other end of its range.

R-E

# market center

## WANTED

**QUICK cash . . .** for electronic equipment components, unused tubes. Send list now! **BARRY**, 512 Broadway, New York, N.Y. 10012, 212 Walker 5-7000

## ELECTRONICS ENGINEERING & INSTRUCTION

**AVIATION ELECTRONICS TECHNICIAN**—Prepare for exciting career in new field of "Avionics". Train at nation's largest aeronautical school. Indicate if eligible for G. I. Benefits. **SPARTAN AIRSCHOOL**, International Airport, MNW, Tulsa, Okla. 74151

**LOGIC NEWSLETTER**, design and construction. Sample copy \$1.00. **LOGIC NEWSLETTER**, Box 252, Waldwick, N.J. 07463

**SHORTCUTS** to success! Highly effective, profitable short courses. (75 choices). Study at home. Diploma awarded. Our 27th year. Free literature. **CIEE-E**, Box 10634, Jackson, Miss. 39209

**TV TUNER repairs**—Complete course details. 12 repair tricks. Many plans. Two lessons, all for \$1. Refundable. **FRANK BOCEK**, Box 3236 (Enterprise), Redding, Calif. 96001

## FOR SALE

**PRINTED circuits**—Free pricing guide determines costs for any quantity. **BLAKESLEY ELECTRONICS**, Box 686B, Syracuse, Ind. 46567

**RECORD telephone conversations**—automatically. Leave recorder unattended. **ROBERT'S**, Box 49RE, Parkridge, Ill. 60068

**CLASSIFIED COMMERCIAL RATE** (for firms or individuals offering commercial products or services). \$1.00 per word . . . minimum 10 words.

**NONCOMMERCIAL RATE** (for individuals who want to buy or sell personal items) 70¢ per word . . . no minimum.

**FIRST WORD and NAME** set in bold caps at no extra charge. Additional bold face 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. Misleading or objectionable ads not accepted. Copy for May issue must reach us before Mar. 1.

## CLASSIFIED ADVERTISING ORDER FORM

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30
31	32	33	34	35

No. of Words { @ .70 Non-Commercial Rates } = \$  
 { @ \$1.00 Commercial Rate } = \$  
 No. of Words in bold face @ .10 = \$

Total Enclosed \$ \$

Insert \_\_\_\_\_ time(s)

Starting with \_\_\_\_\_ issue

Payment must accompany order unless placed through accredited advertising agency 28

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

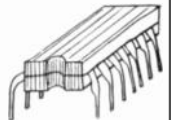
CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_

SIGNATURE \_\_\_\_\_

MAIL TO: RADIO-ELECTRONICS, CLASSIFIED AD DEPT., 200 PARK AVE. SOUTH, NEW YORK, N.Y. 10003

## IC PRICES SLASHED FACTORY FIRSTS

NATIONALLY KNOWN BRANDS SATISFACTION GUARANTEED



DIGITAL TTL	
7400N	22¢
7401N	22¢
7402N	22¢
7403N	22¢
7404N	24¢
7410N	22¢
7420N	22¢
7430N	22¢
7440N	22¢
7441N	\$1.20
7442N	\$1.15
7447N	\$1.02
7451N	22¢
7453N	22¢
7454N	22¢
7472N	35¢
7473N	46¢
7474N	42¢
7475N	72¢
7476N	50¢
7486N	52¢
7490N	72¢
7492N	72¢
7493N	72¢
7495N	\$1.05
74107N	47¢
74121N	51¢

"5% OFF TTL IC PRICES AT 100 PCS TTL IC MIXED.

## LINEAR INTEGRATED CIRCUITS

709C TO-5 DIP or MINIDIP	38¢	10/\$3.50
710C TO-5 or DIP	38¢	10/\$3.50
723C TO-5	90¢	10/\$8.25
741C TO-5 DIP or MINIDIP	40¢	10/\$3.70
748C TO-5 DIP or MINIDIP	43¢	10/\$3.95
558 (DUAL 741) MINIDIP	75¢	10/\$6.75
558 (DUAL 741) TO-5	90¢	10/\$8.25
LM309K TO-3	\$2.25	5/\$10.00

## GENERAL PURPOSE SILICON TRANSISTORS

2N3638 PNP	20¢	10/\$1.65	100/\$15.00
2N3638A PNP	22¢	10/\$1.80	100/\$16.50
2N3641 NPN	23¢	10/\$2.00	100/\$17.50
2N3643 NPN	23¢	10/\$2.00	100/\$17.50
2N5133 NPN	15¢	10/\$1.25	100/\$10.00
2N5134 NPN	15¢	10/\$1.25	100/\$10.00
2N5137 NPN	18¢	10/\$1.50	100/\$13.65
2N5138 PNP	15¢	10/\$1.25	100/\$10.00
2N5139 PNP	15¢	10/\$1.25	100/\$10.00

## 1 AMP SILICON SUBMINIATURE RECTIFIERS

1N4005 600PIV	10/\$1.00	100/\$7.50
		1000/\$60.00
1N4007 1000PIV	7/\$1.00	100/\$9.95
		1000/\$84.00

## DTL INTEGRATED CIRCUITS DIP PACKAGE

930, 936, 945, 946 and 962 . . . Specify number of each type . . . 20¢ 10/\$1.75 100/\$16.00

## SILICON SIGNAL DIODES

1N4148 (1N914 equiv.) . . . 20/\$1.00, 100/\$4.00

## RTL INTEGRATED CIRCUITS TO-5 EPOXY PACKAGE

uL900, uL914 and uL923 . . . Specify number of each type . . . 5/\$1.00 100/\$15.00

## MOLEX IC SOCKET PINS

100/\$1.00 200/\$1.80 300/\$2.60 500/\$4.20  
700/\$5.80 1000/\$8.20 ea addn 1000/\$7.50

## READOUT TUBES

5 Volt 7 Segment Readout Tube \$2.95. Counting and Display Kit (Readout Tube +7490+7475+7447) \$5.25, 3 Kits for \$15.00

## 1/2 WATT 10% RESISTORS

Pick Values 4¢ 25/75¢ 100/\$2.50 500/\$11.25

Free Catalog—Large Quantity Discounts—Orders Less Than \$10.00 Add 25¢—Others Postpaid

**DIGI-KEY** PRICE PACESETTER FOR QUALITY IC'S  
BOX 126H THIEF RIVER FALLS, MN56701

Circle 101 on reader service card

# WORLD FAMOUS Dollar Stretchers

- 1-2N3055 npn, 100w 15A, TO-3, transistor \$1
- 2-2N3529 PNP, 85 watts, TO-32, plastic transistor \$1
- 3-ER900 TRIGGER DIODES for SCRs, Triacs \$1
- 4-2.5 AMP 1000 PIV ITR, silicon epoxy rectifiers \$1
- 5-VARACTOR DIODES, 10pf, 20pf, 30pf, 40pf, 50pf \$1
- 6-FET'S 2N5457 N channel 5000 umho, TO-92 plastic \$1
- 7-90 WATT PNP, 15A, 2N2612, TO-3, silicon \$1
- 8-2N389 npn, silicon, 85 watts, Vee too, square case \$1
- 9-2N1212 npn, silicon, 85 watts, Vee 60, stud case \$1
- 10-1N914 fast switch diodes, silicon 4 nanoseconds \$1
- 11-2N404 germanium npn, TO-5 chrome case \$1
- 12-6 AMF TRIAC 200 PRV, TO-5 \$1
- 13-GE MICRO MINI RECTIFIERS, silicon, porcelain to 1 KV \$1
- 14-RECTIFIERS & ZENERS, 1W & 1A, bullet, assorted volts \$1
- 15-WORLD'S SMALLEST RECT. & zener, 1W, assorted volts \$1
- 16-FAIRCHILD 2n3919 80mc, 15W, npn, 10A, TO-66 \$1
- 17-2N3638 PNP, silicon, TO-6 plastic transistors \$1
- 18-2N4269 NPN, silicon, TO-5 plastic transistors \$1
- 19-2N4269 NPN, silicon, TO-5 plastic transistors \$1
- 20-FET'S 2N3085 N channel, 10,000 umho TO-18 transistors \$1
- 21-PUTS, prog. uni-transistors, similar to GE-D13T \$1
- 22-2N2608 P channel, 2500 umho, TO-18 \$1
- 23-2N3819, Texas, N channel, 8500 umho, TO-18 \$1
- 24-TRIGGER DIODES, for SCRS only, axial leads \$1

### ALPHA-NUMERIC 7-SEG. READOUTS

**2.50** 3 for \$8.

MINI-7 1.75 x 1.75 Characters  
SLIM-7 1.6 x 0.375 " .40 x .20" 1.5V AC/DC 42 mils

\*Compatible to 7-segment driver IC's.

All 3 have 0-9 numerals, decimals and letters. SLIM-7

- 1-2N2646 UNIJUNCTIONS, plastic transistors, Texas \$1
- 2-2N107, GE, most commonly used npn, germanium \$1
- 3-3 AMP 1000 PIV epoxy bullet, silicon rectifiers \$1
- 4-GERMANIUM, glass rectifiers, computer, axial leads \$1
- 5-GERMANIUM, glass rectifiers, glass leads \$1
- 6-2N170, GE, RF, germanium, npn, transistors, TO-22 \$1
- 7-1 AMP 1000 PIV, epoxy, submini, silicon rectifiers \$1
- 8-500 MW ZENERS, axial 4, 6, 9, 10, 12V rectifiers \$1
- 9-2N3055, HOBBY, 40W npn silicon transistors, TO-3 \$1
- 10-2N1855, HOBBY, 10W germanium transistors, TO-3 \$1
- 11-50 AMP SILICON RECTIFIERS, silicon 6, 12, 24 volts \$1
- 12-2N1038, TEXAS, germanium npn, 20 watts, TO-5, w/slink \$1
- 13-2N3054 hobby, npn, TO-66, silicon, 30W, 30mc \$1
- 14-SCRS, assorted voltages, TO-5, TO-18, TO-46 \$1
- 15-3 AMP ZENERS, silicon, epoxy, assorted V, axial \$1
- 16-SN7441M, hobby, BCD-to-decimal driver IC, DIP \$1
- 17-LINEAR AMPS, 709, 710, 711, 741, TO-5 \$1
- 18-709 LINEAR AMPS, 741's too, DIP's \$1
- 19-HOBBY MEMORY CELLS, SN7481, up to 16-cell DIP \$1
- 20-4 MOSFET LINEAR AMPS, brand new, flat pak \$1
- 21-2N6109 40-WATT PNP PLASTIC TRANSISTORS, for any 540 \$1
- 22-723 VOLTAGE REGULATORS, TO-5 \$1
- 23-1000 HFE DARLINGTON transistors, TO-18 case \$1
- 24-2N5036 HI PWR plastic trans 100 veeo, 7 amp 85 watts \$1
- 25-2N5259 HOBBY PNP, 35 watts, plastic transistors \$1
- 26-2N6109 HOBBY 40 watts, plastic power PNP \$1
- 27-PLASTIC 35W powers, npn, silicon, hobby 2N6121 \$1
- 28-PLASTIC 35W powers, npn, silicon, hobby 2N6124 \$1
- 29-MOS FETS, N channel 10 umhos 3N128, TO-18, RCA \$1
- 30-MOS FETS, P channel, 3N187-1, TO-18, RCA \$1
- 31-MOS FETS, DUAL GATE, 3N187-1, TO-18, RCA \$1
- 32-4 RCA 2N3600 NPN, UHF transistor, tv-fm, TO-18 \$1

### LED-PHOTO-SOLAR DOLLAR STRETCHERS

- 3-"LEDS", visible, micro-miniature, axial leads \$1
- 4-"LEDS", infrared, jumbo, TO-18 \$1
- 5-"LEDS", visible, jumbo, red, TO-18 \$1
- 6-"LEDS", visible, parabolic reflector, RCA \$1
- 7-PHOTO TRANSISTOR, with darlington amp filter, lens \$1
- 8-PHOTO TRANSISTORS, with darlington amp, 2N5777, GE \$1
- 9-PHOTO CELLS, Clairax, pancake, 30K-70 ohms \$1
- 10-SOLAR CELLS, round, sq, rect., sun power circuits \$1
- 11-SILICON SENSORS, TEXAS, HI-38 Matchless, visible \$1

- ### SUPER ECONOMY \$1 PARTS "DOLLAR STRETCHERS"
- 30-POWER RESISTORS, 3-to-25w, square, vitreous, ass't vals \$1
  - 31-REED SWITCHES, 2" long, fastest mech. switch \$1
  - 32-MICRO MOTOR SWITCHES, 1/2" long, transistor work \$1
  - 33-TRANSISTOR SOCKETS, for npn, pnp, germanium, too \$1
  - 34-\$25 SURPRISE PAK, resistors, caps, transistors, etc. \$1
  - 35-TERMINAL STRIPS, 1-to-8 screw & tie lugs \$1
  - 36-RADIO & TV KNOBBS, ass't shapes, colors, styles \$1
  - 37-SOL FETS, 2N55, 65mf to 0.1mf, space-savers \$1
  - 38-PRE-FORMED DISC, condensers, for circuit \$1
  - 39-PHONO PLUG-AND-JACK SETS, tuners, amps, doubles too \$1
  - 40-KODAK LENSES, piano convex, concave, convex, mirror \$1
  - 41-TUBE SOCKETS, receptacles, plugs, audio, etc. \$1
  - 42-PRE-FORMED DISCS, 485 kcs, 3" square, transistor \$1
  - 43-DIPPED SILVER MICAS, 1/2 watt, 1/2 watt, printed etc. \$1
  - 44-COILS & CHOKES, H, I, ant. peaks, osc. parasitic \$1
  - 45-IC SOCKET-ADAPTERS, TO-5, DIPs, flat, handy \$1
  - 46-PRECISION RESISTORS, 1/8, 1/2, 1 & 2W, 1% ass't vals \$1
  - 47-TUBULAR RESISTORS, 1/2, 1, 2W, 1% ass't vals \$1
  - 48-SUBMINIATURE ICS, 5mf to 300mf, upright too \$1
  - 49-TUBULAR ELECTROLYTICS, to 100mf, for ac/dc sets, etc. \$1
  - 50-NE-2 NEON BULBS, for 110vac, 100's of projects \$1
  - 51-POLYSTYRENE CONDS, finest caps made, ass't values \$1
  - 52-TWO WAYS, 110vac, micro, rotary, thermal, slide, \$1
  - 53-VOLUME CONTROLS, to 1meg, dual too, some w/switch \$1
  - 54-MICRO MINI RESISTORS, 1/4w, 100 ohm to 1meg, 5% \$1
  - 55-MOLDED CONDENSERS, 1/4w, axial, to 1mf to 1KV \$1
  - 56-ONE WATT RESISTORS, 1% & 5%, AB's too, 100 to 1 meg \$1
  - 57-TRANSISTOR ELECTRO'S, 5mf to 300mf, upright too \$1
  - 58-CERAMIC CONDENSERS, 10mf to .04, npn, discs \$1
  - 59-MICRO-MICRO-MINI CONDENSERS, to .06mf Cerafil \$1
  - 60-IBM COMPUTER BOARDS, trana, caps, res, coils, etc. \$1
  - 61-ELECTROLYTIC MOTORS, 1/2, 3/4, 1, 2, 3 sec. too \$1
  - 62-TRIMMER POTS, 100, 500, 2K, 5K, 10K, 25K, 1/2w, snap-in \$1
  - 63-HI-Q RESISTORS, carbon, 1/4, 1/2, 1, 2W 5% \$1
  - 64-DISC CAPACITORS, 10mf to .05, npn's, hi-Q, to 6KV \$1
  - 65-MICA CAPACITORS, to .01, to 1KV, silvers too, ass't \$1
  - 66-TWO WAYS, 110vac, micro, rotary, thermal, slide, \$1
  - 67-MICRO POTS w/ knob, snap-in, 1/5W, 25, 50K, 100K, 1meg \$1
  - 68-PRINTED CIRCUIT PARTS, electro's, trans, etc. \$1
  - 69-YELLOW PACKET MYLARS, assorted values & sizes \$1
  - 70-POWER TRANSISTOR SOCKETS, for TO-3, ass't types \$1
  - 71-"MINI-RES" MOTORS, 1/2, 3/4, 1, 2, 3 sec. high speed \$1
  - 72-PLASTIC TRANSISTORS, TO-18, printed circuit \$1
  - 73-CRAMER 28 VAC, 4 rpm, 60 cy timing motor \$1
  - 74-100-pc PARTS, BOURN's pots, transistors, diodes, etc. \$1
  - 75-110 VAC MERCURY SWITCHES, press-Bit, 1" long \$1
  - 76-HELICAL FLASH TUBE, retriggerable, gas, strobe, etc. \$1
  - 77-MICRO-MINI METER, 1/2" dia, W, 6 sec. 0.5 fits in \$1
  - 78-MINI MOTORS, sealed, 1 1/2 to 12VDC, hi-speed \$1

### PHILCO-FORD Replacement for tape recorders, PA systems, audio amps. 200 ohms. 6-ft. cord and mini mike plug. 200-600 Hz. W, 6 sec. 0.5 fits in palm of hand.

**\$1.98 DYNAMIC MIKE**

2 1/2" x 1 1/2" x 1/2"

Designed by our Scientific Device engineers as the most advanced digital timing device in the consumer timing field. One radio-and-TV station engineer tells us, "Not a change of a second in 3 months." It is so accurate we use it as our standard. KRONOS KR100 Series, in the new sleek all-purpose walnut-and-black modern design cabinet, enhances any office, home, den, etc. It becomes a "visible-action conversation piece," wherever it is placed. Has modern LSI National Clock Chip, and 8-page brochure chock-full with pictorials and easy-to-understand, step-by-step instructions. This kit is COMPUTER SIMPLIFIED making do-it-yourself easy! Other features include 3 setting controls, 1 hour per second, 1 minute per second, and hold button. Easy-to-change from 12 to 24 hours, 4 to 6 digits, 50 to 60 Hz operation. Your choice of 4 different type readout systems:

- KR101 7-Segment MAN-3 Type LED, 6 Digits \$57.00
- KR102 7-Segment MAN-1 Type LED, 6 Digits \$79.95
- KR104 Elfin 7-Segment Nixie Type Tubes \$57.00

Size of cabinet: 6" x 5 1/4" x 6" deep

## KRONOS Only \$57.

With Cabinet

### 'TIME STANDARD' CHRONOMETER



## Lowest Prices Largest Selection TTL IC's

Brand New "DIP" Packages Order by type number! Spec sheets on request "ONLY"

Type	Sale	Buy 100 - Take 20%	Buy 1000 - Take 20%
SN7400	\$2.25	SN7437	.50
SN7401	.25	SN7438	.51
SN7402	.25	SN7440	1.30
SN7403	.25	SN7441	1.30
SN7404	.25	SN7442	1.12
SN7405	.25	SN7443	1.21
SN7406	.45	SN7445	1.21
SN7407	.45	SN7446	1.50
SN7408	.29	SN7447	1.50
SN7409	.29	SN7448	1.25
SN7410	.25	SN7450	.25
SN7411	.25	SN7451	.25
SN7413	.75	SN7453	.28
SN7416	.48	SN7454	.25
SN7417	.48	SN7455	.25
SN7420	.25	SN7456	.21
SN7421	.25	SN7470	.39
SN7426	.32	SN7472	.39
SN7430	.25	SN7473	.44
SN7432	.25	SN7474	.39
		SN7475	1.00

## GIANT SALE ON NATIONAL 'IC'S'

Buy 3 - Take 10% Discount

Type	Description	Buy 3 - Take 10% Discount
DM8091	Tri-State Quad Buffer	\$1.00
DM8093	Tri-State Quad Buffer	1.00
DM8094	Tri-State Quad Buffer	1.00
DM8200	4-Bit Comparator	1.50
DM8210	8 Channel Switch	1.00
DM8220	Parity Generator Checker	1.00
DM8223	Programmable ROM	8.88
DM8250	1024 Bit Decoder	1.00
DM8281	Preset Binary Counter	1.19
DM8288	Preset Divide by 12	1.19
DM8502	Same as 74107	.41
DM8520	Module Divide by 2-18	1.50
DM8555	Tri-State Preset Counter	1.95
DM8680	Binary Counter	1.00
DM8800	Dual Voltage Translator	1.00
DM8820	Dual Buff. Line Driver	1.00
DM8845	Same as SN7446	1.48
DM8845	Same as SN7445	1.45
DM8880	Hi Amp, 7-Seg. Dec. Driver	1.95

## 'How's Your MEMORIES For 1973?'

1101	256 Bit RAM MOS	\$3.50
1103	1024 Bit RAM MOS	8.50
2513	Character Gen. ROM	12.50
7489	64 Bit RAM TTL	3.50
8223	Programmable ROM	7.95
8224	Programmable ROM	12.50
MM5260	1024 Bit RAM	8.88

## NATIONAL "OP" AMPS

Buy any 3 - Take 10% Discount

Type	Description	Buy any 3 - Take 10% Discount
LM-280	2 Watt amplifier	\$1.95
LM-300	Hi-performance amp	1.49
LM-301	Hi-performance amp	1.49
LM-302	Voltage follower TOS	1.49
LM-304	Pos. voltage regulator TOS	1.49
LM-305	Pos. voltage regulator TOS	1.49
LM-307	Super 741	1.49
LM-308	Super gain op amp TOS	1.98
LM-309K	SV 1000V V. regulator TOS	1.98
LM-350	Dual peripheral driver TOS	2.25
LM-370	AGC squelch amp TOS	1.49
LM-373	AM-FM SSB Hi strip TOS	3.75

## LED READOUTS \$2.95

Buy 3 - Take 10% Discount

This display is excellent for small portable electronics, such as DVM's, calculators, etc. Equivalent to Monsanto, etc. Equivalent to Monsanto MAN 3A. Operates from 47, 200 milliampere, with 6V, ohm dropping resistor.

## Potter & Brumfield KAP RELAYS

Your choice for \$2.98

118 VAC 3PDT	\$2.98
12 VDC 3PDT	2.98

Excellent for "HAM" use as antenna switching, latching, transmit, receive, etc., and 100's of commercial or industrial uses. Includes plastic dust-cover with diagram and hookup info, 11-pin plug-in base. Contacts movable gold flashed silver, stationary overlay, with silver cadmate side movables. All contacts 10 amp 3PDT. Coil data, 115VAC 4250 ohms, 17.5 ma, 12 VDC 21.0 ohms 168 ohms. Size: 2 1/2" x 1 1/2" x 1 1/2". 4 oz. Center pin missing. Comar Mfg. type equal too.

Unique Scientific Device, "hand claps", sensitizes crystal mike amplifier, triggers SCR. Needs only 3 to 6vdc. Use as burglar alarm, intrusion device. Photo cell, triggers SCR's, relays, LED's. Even fiber optic light pipe may be used. With hand booklet.

## MAGIC "SOUND TRIGGER" \$1.98

FACTORY GUARANTEED

## NIXIE TUBE SALE \$2.50

Burroughs B1971, 0-to-9, A-to-Z 2 1/2" high characters, 170V.

Type	Price
PIV 2 Amp	\$8.99
50	\$6.99
100	79.45
200	.95
400	1.19
600	1.35
1000	1.78
2000	1.78

Code: 2 amp TO-5 case  
E Amp 1/2 x 1/2 x 3/16 sq

## LINEAR Op Amps

FACTORY TESTED

Type	Price	
531	Hi slew rate op-amp TO-5	\$2.50
532	Micro power 709 TO-8	2.50
533	Micro power 709 TO-8	2.50
536	FET input op amp TO-5	3.95
537	Precision 741 TO-5	2.50
540	70W pwr driver op amp TO-5	2.04
550	Precision 723 voltage reg. (DIP)	1.17
555	Timer 2 microseconds to 1-hour (A)	1.19
558	Dual 741 (A)	.88
560	Phase lock loops DIP	3.25
561	Phase lock loop DIP	3.25
562	Phase lock loop DIP	3.25
565	Phase lock loops (A)	3.25
566	Function generator (Mini DIP)	3.25
567	Tone decoder (A)	3.25
595	Four quadrant multiplier TO-5	3.10
702C	Hi-gain, DC amp, TO-5	.44
703R	RF, IF, amp, 14 ckts, TO-5	1.00
709C	Operational amp (A)	.39
710C	Differential amp (A)	.39
711C	Dual diff. comp (A)	.39
723C	Voltage regulator (A)	.95
741C	Frequency compensator 709(A)	.41
741CV	Frequency comp 709 (mini DIP)	.45
747C	Dual 741C, (A)	1.25
748C	Freq. adj. 741C (A)	.44
709-709	Dual 709C (DIP)	1.00
739-739	Dual stereo preamp	1.98
741-741	Dual 741C (A)	1.00

(A) TO-5 or DIP dual in line pak

## LOW PRICES ON 'TRIACS'

Two SCRs in one case

Type	Price
PRV 3 amp	\$2.22
100	.35
200	.65
400	.92
500	1.25
600	1.50

Most complete listing!

15 amp	\$5.65
15 amp	5.85
15 amp	.85
15 amp	1.05
15 amp	1.45
15 amp	1.65
15 amp	1.95
15 amp	2.25
15 amp	2.65

3 & 6 amp TO-5, 10 amp TO-66, 15 & 25 amp stud.

## STEREO PREAMP IC 1-WATT AUDIO AMP

Dual 739-739 8-transistors per channel. 50K in. imp. for phono-tape 20-20,000 mc. DIP, Fairchild.

Choose Any 1.95 3 for \$4.50

8-transistors in TO-5 case. 400K in. imp. Westinghouse WCC34, TO-5.

## INTEGRATED CIRCUIT SOCKETS

Buy Any 3 - Take 10% Discount!

14-Pin, dual in line	\$4.45
16-Pin, dual in line	2.0
TO-5, 9 or pins	2.0

## POLY PAKS

P.O. BOX 942R, LYNNFIELD, MASS. 01940



**EXCLUSIVE ECONOMY-PACKED**  
**DOUBLE BONUS Sale**  
**BONUS #1**  
**Free \$25**  
 Add 25¢ for handling. PAR  
 PLUS CHOOSE ANY ITEM \$1 OR LESS FREE

**BOTH FREE WITH ANY \$10. ORDER**

**PHILCO 11 TRANSISTOR AM RADIO CHASSIS**

Use as:  
 • Mike amplifier  
 • Phono amplifier  
 • Tape amplifier  
 • Covers 555 Kcs to 1500 Kcs Broadcast band  
**Only \$5.95**

**8 TRANSISTOR AMPLIFIER CHASSIS**  
**Only \$3.95**

Same as above, except no AM radio section. Completely wired with built-in preamp, mike, phono and tape inputs. Color-coded wires with diagram and hookups. Works off 9VDC transistor battery. Excellent fidelity. Shpg. wt. 1 lb.

**AC-DC CHARGER-CONVERTER — Only \$1.98**

Converts above 11-and-8-transistor chassis from 9VDC to 110VAC. Easy to hook in. Use as "NICAD" battery charger too (with instructions). Size: 2 1/4" x 1 1/4" x 1 1/4". 1-lb.  
**5-IN. "HI-FI" PM SPEAKER — Only \$1.98**  
 6-ounce ceramic, cylindrical magnet. Twin voice coil, 4 and 8 ohms. 50-16,000 cycles. Shpg. wt. 3 lbs.

**TEXAS 4-WATT AUDIO AMPLIFIER \$3.95** 3 for \$9  
 Type SN76024. Good up to 70 Hz. 4 W. into an 8-ohm load. High input impedance, VCC 9V to 24. DIP pak with heat sink. 15 transistors, 6 diodes.

**GENERAL ELECTRIC 3-WATT AUDIO AMP \$2.95** 3 for \$8.00  
 Delivers 3.5 watts continuous, 10 watts peak. With heat sink; micro-mini size; 1/2" x 1/2" x 1/2". 9 to 30V supply. High sensitivity. 8 to 16 ohms.

**IT'S NEW! 12-DIGIT "CALCULATOR ON A CHIP" \$1.25**  
 Sorry, can't name U.S. maker! Type SD6001. Similar to Mostek 5012. Outperforms Texas 8-digit TMS-1K02. Features: 40-pin DIP; not 8, not 3, but only single "calculator chip", 12-digit capacity; adds, subtracts, multiplies, divides, fixed point (0, 2, 3 or 4 decimal places), chain operations, leading zero blanking, 7 segment decoded display output, overflow lockout, and negative sign output. Drives incandescent, fluorescent, Nixies, and LED readouts, complete with instruction booklet.

**RADIATION SURVEY INSTRUMENT \$9.95**  
 Wt. 3 lbs; size 5x4x8 1/2".

Victoreen 710B, measures Gamma radiation from 0.1-50 roentgens/hr. This surplus C-D meter is new, guaranteed and comes with a complete manual of instructions, theory of operation, circuitry, detailed parts list. The 20 µa meter is calibrated in roentgens per hour, indicating the presence of gamma radiation. Three multiplier scales (Victoreen 100,000 meg; 10,000 meg; 1,000 meg decade) matched within ±2%  
 0-9 plus letters.  
 Snaps in 14-pin DIP socket. 1/2" x 1/2" x 1/2", characters: 1/4" x 1/4". 5V, 20-mils per seg. characters: 1/4" x 3/16". Famous MAN type.  
 • Sockets .50 ea.

**LED READOUTS \$4.50** 3 for \$12.  
 Type G, 1/2" dia., 1/2" high, Mounts in 1/4" hole, with shaft, linear, immersion-proof high freq.

Ohms: 75 2.0K 7.5K 25.0K 2 for \$1  
 100 2.5K 10.0K 75.0K  
 500 5.0K 20.0K 100.0K 5 Meg  
 \* See Lockout Bushing & Screwdriver types at same low prices.

**ALLEN BRADLEY 'MICRO-POTS'**  
 Type F. Screwdriver adjust.  
 Ohms: 75 250 1.0K 7.5K 25.0K 250R 4 for \$1  
 100 800 2.5K 10.0K 50.0K 2 Meg  
 200 750 3.0K 20.0K 75.0K 5 Meg

**ALLEN BRADLEY'S 'TRANSISTOR' POTS**  
 Ohms: 100K Any  
 75 250 1.0K 7.5K 25.0K 250R 4 for \$1  
 100 800 2.5K 10.0K 50.0K 2 Meg  
 200 750 3.0K 20.0K 75.0K 5 Meg

Retail: 16-18 Del Carmine St., Wakefield, Mass.  
 Terms: add postage, odd's 25 ¢. Rated net 30  
 Phone Orders: Wakefield, Mass. (617) 245-3829  
 C.O.D.'S MAY BE PHONED IN  
 P.O. BOX 942R  
 Lynnfield, Mass. 01940

**COUNTING SYSTEM \$4.50**  
 Includes SN7441, SN7475, SN7490, 0 to 9 National Nixie tube, sheets. 3 for \$12.00

**MAN-4 EQUAL READOUT \$3.95** Buy 3 — Take 10%  
 0-9 plus letters, for SN-7448. Snaps in 14-pin DIP socket. 1/2" x 1/2" x 1/2". 5V, 15ma, with decimal point. Like MAN-4.  
 • Socket for above, 50¢

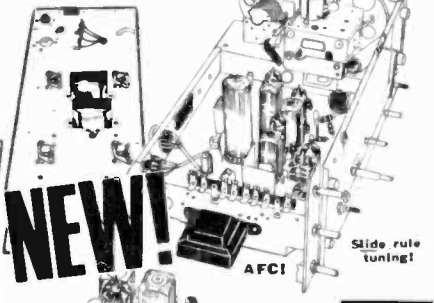
**6VDC 6AMP/HR MOTORCYCLE BATTERY \$5.95**  
 • Compact • Needs only Electrolyte • Worth Use as power pak for mobile \$10-rige & many "Ham" components, other electronic projects. Size: 5 1/2" tall x 4 1/2" wide over all x 2 1/4" Shipped dry, must be filled before use.

**35 WATT AUDIO AMPLIFIER BASIC \$3.33**  
 For Class AB use. Basic includes: Signetec 540 30 transistor high power driver TO-5 w/alt. plastic transistor, i.e. 2N5296 npn and 2N6109 pnp. With schematics, printed circuit and parts board layouts.

**POLY PAKS**  
 P.O. BOX 942R  
 Lynnfield, Mass. 01940

**AM-FM-STEREO-MUX SOUND CONTROL CENTER**

Only \$29.95



**NEW!**  
 AFC! Slide rule tuning!  
 FM freq: 88 to 108 mc/l  
 AM: 550 to 1600 kc/l  
**SEPARATE ESCUTCHEON \$4.95**  
 Shpg. wt. for 3-pc. Sound Control Center — 10 lbs.

**HYBRID FEATURES**

- AM, FM, FM-Multiplex stereo phono inputs!
- Separate Tuner! Amplifier and Multiplex!
- FM Tuner has automatic frequency control!
- Hybrid tube, transistor printed circuitry!
- Separate volume and power control!
- Separate bass and treble controls!
- Remote speaker controls!
- Connects easily to record changer!
- Mike. tape. phono inputs!
- Push-pull power output solid state!

This is a Poly Pak exclusive. Bought for the economy-minded hi-fies. This unique audio system was designed for \$300 consoles. 16 watts of stereo music power, 3 separate units, each unit professionally designed by U.S.A. engineers. AM-FM tuner, Multiplex, push-pull TO-66 power transistors mounted on chassis. Outputs connect to any good speaker system. Voice coils of 8 to 16 ohms. Unique switch on panel connects external stereo speakers to other parts of room, home or office. Concentric volume controls for perfect stereo balance. Has built-in preamplifier, built-in AM antenna. 13" x 6" x 8".

**TUNER — 13" x 6" x 8"**  
 Tuner uses 17C9 for FM r-f amplifier and converter, 12BA6 for 1st FM f-amp and AM f-amp, 12BA6 for 2nd FM f-amp and AM detector, 12BE6 AM converter, 12AX7 multiple preamp. Separate speaker arrangements for hi-fi and TV. Built-in AFC. Comes complete with 8-pg. 8 1/2" x 11" factory booklet, check-off of diagrams, printed circuit layouts of all parts, etc. All parts are easily identified. Power consumption 116 VAC 60 cy. Complete with all interconnecting cables. Wide frequency response. Includes printed front panel template. WHERE CAN YOU GET SO MUCH AM! FM! STEREO! FOR SO LITTLE MONEY?

**MULTIPLEX — 4" x 6" x 3"**  
 Multiplex uses 12AT7 amp-doubler, 12AX7 35 ke output amp, with availability of "STEREO STATION INDICATING" lamp.

**POWER AMPLIFIER CHASSIS — 12" x 6" x 2"**. All solid state devices, using a pair of driver transistors to push-pull TO-66 "Sound Control Center" power.

**DIGITAL CLOCK ON A CHIP**  
 only \$14.95

SD-6314 direct substitute to famous U.S. maker. 24-Pin DIP — IMAGINE! ONE CHIP ELIMINATING 16 and other parts. Space Saver! Money saver! Latest in clock design. Features 12 or 24-hr. operation, 4 or 6 digits, 40 or 60 Hz operation. Internal digit multiplex oscillator, leading zero blanking, high output current for simple readout interface. Single power supply operation. Digit blanking for reduced current drain, 11 thru 19 volt range. Full MOS LSI. Spec sheets included.

**ONE-MAN ELECTRONIC FACTORY**

Investment unnecessary, knowledge not required, sales handled by professionals. Ideal home business. Write today for facts! Postcard will do. Barta-DRB, Box 248, Walnut Creek, CA 94597.

JAPANESE new products monthly! \$1.00. Re-fundable. DEERE, P.O. Box 9308, North Hollywood, Calif.

MANUALS for Govt. surplus radios, test sets, scopes, teletypes. List 25¢. BOOKS, 4905 Roanne Drive, Washington, D.C. 20021

PRINTED circuit negatives made. SASE and quarter for information/prices. P-C NEGA SYSTEMS, 186-80th Street, Niagara Falls, N.Y. 14304

IC MANUAL LISTING MORE THAN 500 COMMON DIGITAL IC'S WITH PIN CONNECTION DIAGRAMS, \$2.75. ELECTRONETICS, Box 278, Cranbury, N.J. 08512

SEMICONDUCTOR and parts catalog. J. & J. ELECTRONICS, Box 1437, Winnipeg, Manitoba, Canada

ELECTRONIC ignition—various types, information 10¢. ANDERSON ENGINEERING, Epsom, N.H. 03239

PHOTOFLASH: FT 106C, 800µF, trigger coil—\$12.50. Catalog. TRANSPARK Dept. R., Carlisle, Mass. 01741

FREE catalog lists resistors, tubes, transistors, rectifiers, condensers, tools, tuners, etc. etc. HYTRON HUDSON, Dept. RE 2201 Bergenline Ave., Union City, N.J. 07087

EXPERIMENTERS. Find out how to tell type of transistors on surplus IBM boards without test equipment. Send \$1.00 for booklet Tran-25. RESTEK, 525 Copper Ridge, Richardson, Tex. 75080

CANADIAN surplus catalog \$1.00. ETCO ELECTRONICS, 464B McGill, Montreal, Canada

DIGITAL ELECTRONICS! Complete schematics, parts lists, theories—Discrete Component Digital Clock, \$3.00—Sound Sensitive Switch, \$1.50. Increase technical competence, hobby skills—Complete course in Digital Electronics is highly effective, \$10.00. Free literature. DYNASIGN, Box 60R2, Wayland, Mass. 01778

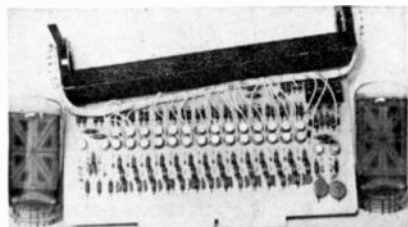
**ENJOY TALK-FREE FM MUSIC!**  
 Plug in "Musicon MX-7" adapter to any FM tuner or receiver for continuous, soothing FM music. Enjoyed by thousands. Works in your area or prompt refund. Line powered, compact, never needs adjustment. Guaranteed for 5 years. FREE — list of SCA stations with order. Send \$39 (ppd) check or M.O. K-LAB, Box 572 S. Norwalk, Conn. 06856.

**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-DRB, Box 248, Walnut Creek, CA 94597.

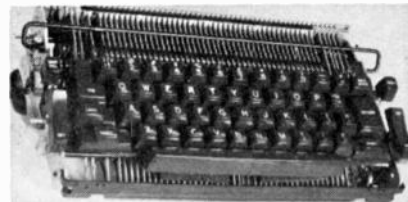
**FREE Catalog**  
 OF THE WORLD'S FINEST GOVERNMENT SURPLUS ELECTRONIC EQUIPMENT  
 And BETTER Than Ever  
 Name \_\_\_\_\_  
 Address \_\_\_\_\_  
 City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_  
 Mail Coupon for Your FREE Copy, Dept. RE  
**FAIR RADIO SALES**  
 1016 E. EUREKA • Box 1105 • LIMA, OHIO • 45802



**GIANT B-7971 NIXIES (2) with 2 sockets and driver board containing hi voltage transistors. Complete plug-in board as removed from operational equipment. Schematics included. Unbelievable but true . . . just \$2.50 for the complete package.**  
#72S-10 \$2.50



**ALPHA-NUMERIC keyboard removed from unused IBM Selectric machines. Bargain price at only \$8.00**



**15¢ IC BONANZA**

Brand new DTL dual inline (DIP) package, factory marked ceramic type. The price is too good to be true. Fully guaranteed and with specs.

930 Dual 4 input NAND gate similar to	7420
931 Clocked flip flop	74110
932 Dual 4 input Expand Buff	7440
933 Dual 4 input expander	7460
936 Hex Inverter	7405
945 JK Flip Flop	74110
946 Quad 2 input gate	7400
962 Triple 3 input gate	7410

15¢ each. Buy \$100 worth and deduct 10%

24 hour delivery guaranteed.

Please add postage for above.

JOHN MESHNA JR.

PO Box 62, E. LYNN, MASS. 01904

Circle 103 on reader service card



**FREE**

**SWT CATALOG**

Now Get

**MUSIC ONLY FM Programs**

Convert ANY FM TUNER to receive uninterrupted commercial free music being broadcast by many stations.



New three transistor plus "Phase locked loop" IC circuit gives you perfect reception. No tuned circuits, or critical adjustments. The 1 1/2" x 4" circuit board is powered from the tuner supply. +9 to 12 Volts DC @ 10 Ma. required.

Kit Only

**\$1450**

With Squelch

**\$1950**

Wired & Tested

**\$2500**

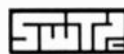
Free list of FM stations with SCA authorizations included (List alone \$.25)

With Squelch

**\$2995**

BankAmericard  
or  
Master Charge  
Welcomed

Plus Postage  
and Insurance.  
**THOUSANDS  
SOLD**



**SOUTHWEST TECHNICAL  
PRODUCTS CORPORATION**

BOX 32040 R • SAN ANTONIO, TEXAS 78284

Circle 104 on reader service card

## Technical Excellence in Electronics.

On our small, friendly campus the emphasis is on Living as well as Learning. Extra-curricular social activities, student clubs, a student operated radio station, student government, new dormitory and a full sports program help provide a world of your own in which to prepare for tomorrow. Associate Degree in Engineering Electronics. B.S. obtainable. G.I. approved.



**VALPARAISO TECHNICAL INSTITUTE**  
Dept. C, Yellowstone Trail, Valparaiso, Indiana 46383

**PARTS! CORNELL TUBES!**  
FREE Send For FREE  
CORNELL'S New Color Catalog  
**33¢** per tube  
**36¢** per tube  
ORDER FREE IF NOT SHIPPED IN 24 HOURS!  
48 Pgs. New Items IN LOTS OF 100  
**4215 E UNIVERSITY AVE. SAN DIEGO, CALIF. 92105**

**STAR-TRONICS**  
**INDUSTRIAL AND GOVERNMENT  
ELECTRONIC SURPLUS**  
PARTS & PIECES FOR SCHOOLS, SHOPS, HAMS & HOBBYISTS  
SEND FOR OUR LATEST ALL DIFFERENT  
MONTHLY PICTURE CATALOG. NOW!  
**Box 17127, Portland, Ore. 97217**

**MOST VERSATILE FURNITURE PADS**  
**Stereo Theatre TRUCK DEVELOPED!**  
16.95 each  
\$69.95 per dozen  
12.95  
CONSOLS TV COVER  
12.69  
YEATS PLATFORM DOLLY  
STANDARD MODEL No. 7  
\$89.50  
FREE Illustrated brochure  
**YEATS dollies**  
1324 W. FOND DU LAC AVE.  
MILWAUKEE, WIS. 53205

**BUILD A "SPACE-AGE" TV CAMERA!**  
ONLY KNOWN SOLID-STATE CAMERA IN KIT FORM!  
Also available factory assembled. Ideal for experimentation, industry, education, etc. High quality performance backed by over seven years of lab and field testing. Fully Guaranteed. Completely self-contained. Connects to any TV set without modification. Easy-to-follow assembly manual. Model XT-1A, Series D complete with vidicon \$169.95. (Available in USA & Canada (less vidicon tube \$116.95)). Many other kits, parts and plans also available.  
PHONE or WRITE for CATALOG.. DIAL 402-987-3771  
BOX 453-RE **ATV Research** DAKOTA CITY, NEBR. 68731

**DIGITAL CLOCK** **LOGIC PROBE**  
KIT - \$59.95 Ppd.  
Wired - \$89.25 Ppd.  
Beautiful walnut/metal case Only 3 1/2" x 3 1/4" x 7"; BCD output LARGE Sperry display - .55" h. 26 page manual only - \$2.50  
Free info., these & other digital kits, request cat. # D-8 Master Charge, BankAmericard & COD orders welcome.  
MUNICUTT DIGITAL ELECTRONICS, Box 9793, Ft. Worth, Tex. 76107

**PAIA's Surf Synthesizer**  
The roar of the surf electronically synthesized and played through your hi-fi.  
No. 3711K \$11.95  
Other Kits:  
NO. 3721 ELECTRONIC WIND CHIMES \$6.95  
NO. 1770 SOLID STATE BIRD \$6.95  
Plus electronic music accessories and many more.  
Please add 50¢ postage & handling to orders.  
Write for FREE Catalog  
**PAIA ELECTRONICS**  
**BOX R14359, OKLAHOMA CITY, OK 73114**

## ADVERTISING INDEX

**RADIO-ELECTRONICS does not assume responsibility for any errors which may appear in the index below.**

READER SERVICE CARD NO.	PAGE	
68	Acoustic Research .....	85
92	Aries, Inc. ....	103
17	Arrow Fastener Co., Inc. ....	32
93	Babylon Electronics .....	104
	Bell & Howell Schools .....	46-49
88	B.F. Enterprises .....	101
7	B & K, Division of Dynascan Corp. ....	15
13	Blonder-Tongue .....	24
81	Brooks Radio & TV Corp. ....	96-97
64	BSR USA Ltd. ....	84
96	Castle TV Tuner Service, Inc. ....	Cover III
26	Channelock, Inc. ....	80
22	Chemtronics, Inc. ....	78
10	Cleveland Institute of Electronics .....	18-21
	CREI, Division of the McGraw-Hill Continuing Education Co. ....	74-77
6	Crown International .....	14
71	Crystek .....	87
94	Delta Electronics .....	104
61	Delta Products, Inc. ....	82
65	Dictaphone Corp. ....	84
95	Edmund Scientific Co. ....	110
79	EICO, Electronic Instrument Co. ....	96
70	Electronic Chemical Corp. ....	86
67	Electronic Distributors, Inc. ....	85
11	Electro-Voice, Inc. ....	22
	EMC, Electronic Measurements Corp. ....	98
86	Enterprise Development Corp. ....	100
23	Fordham Radio Supply Co. ....	78
19	Garrard (British Industries Corp.) .....	34
78	GC Electronics .....	91
76	Grantham School of Engineering .....	89
	GTE Sylvania Electronic Components .....	23
	Heath Co. ....	92-95
1	ICS School of Electronics .....	1
27	Indiana Home Study Institute .....	80
28	International Components Corp. ....	81
73	International Crystal Mfg. Co. ....	88
83	International Electronics Unlimited .....	98
20	International Rectifier Corp. ....	70
69	Keithley Instruments, Inc. ....	86
18	Leader .....	33
87	Lee Electronic Labs .....	100
89	Magitran Co., The .....	102
16	Micro-Instrumentation Telemetry Systems, Inc. ....	27
66	National Camera Co. ....	84
	National Radio Institute .....	8-11
	National Technical Schools .....	28-31
8	Olson Electronics .....	16
62	Oneida Electronic Mfg. Co., Inc. ....	83
	Panasonic .....	Cover II
90	Pennwood Numechron .....	102
85	PTS Electronics, Inc. ....	99
9	Quam-Nichols .....	17
75	Quietrole .....	89
21	Raytheon Co. ....	73
	RCA Institutes .....	64-67
5	RCA Parts & Accessories .....	13
	RCA Electronic Components Semiconductors .....	79
25	Semiconductors .....	81
29	Semiconductors .....	83
63	Semiconductors .....	83
14	Test Equipment .....	25
80	Rye Industries, Inc. ....	97
84	S & A Electronics .....	99
24	Schober Organ .....	79
2	Shure Bros. ....	2
74	Sonar Radio .....	88
4	Sony Corp. of America .....	7
77	Sprague .....	90
82	Telematic .....	98
72	Telex .....	87
3	Tuner Service Corp. ....	5
91	TV Tech Aids .....	102
15	Tecron .....	26
97	Winegard .....	Cover IV
12	Xcelite .....	22
	<b>MARKET CENTER</b> .....	<b>105-109</b>
	ATV Research Corp. ....	108
	Barta-DRB .....	107
	Command Productions .....	109
	Cornell Electronics .....	108
101	Digi-Key .....	105
	Fair Radio Sales .....	107
	Hunnicut Digital Elec. ....	108
	K-Labs .....	107
	Lakeside Industries .....	109
103	John Meshna Jr. Electronics .....	108
	PAIA Electronics .....	108
102	Polypaks .....	106-107
105	Solid State Sales .....	109
104	Southwest Technical Products .....	108
	Star-Tronics .....	108
	Yeats Appliance Dolly Sales Co. ....	108
	<b>SCHOOL DIRECTORY</b> .....	<b>108</b>
	Valparaiso Technical Institute .....	108

**PRINTED** circuits—low cost, **CIRKUT BOARDS** Box 3193 Station C, Toledo, Ohio 43607

**LOGIC** Probe with LED display \$20.00 post-paid U.S. Order from UTI POB 252 Waldwick, N.J. 07463

**B & K, SENCORE TEST EQUIPMENT, DISCOUNT PRICES. FREE CATALOG AND PRICE SHEET. FORDHAM RADIO, 558 MORRIS AVENUE, BRONX, N.Y. 10451**

### TAPE & RECORDERS

**1/2 INCH VIDEO TAPE, \$6.00 PER HOUR** on 7" reel. Free information. **OREGON MAGNETICS, Box 13374, Portland Ore. 97213**

**RENT 4-track open reel tapes—all major labels—3,000 different—free brochure. STEREO-PARTI, 55 St. James Drive, Santa Rosa, Calif. 95401**

### PLANS & KITS

**BUILD your own TELEPHONE ANSWERING SERVICE.** Detailed plans \$3.90. **TONASCOPE-C** 400 Third Ave., Satellite Beach, Fla. 32937

**BUILD 32-FUNCTION DIGITAL COMPUTER 24-PIN IC, 12 TRANSISTORS, COMPLETE INSTRUCTIONS, \$15.25. ELECTRONETICS, Box 278, Cranbury, N.J. 08512**

**CONVERT** any television to sensitive big-screen oscilloscope. Only minor changes required. No electronic experience necessary. Illustrated plans \$2.00. **RELCO—A25, Box 10563, Houston, Tex. 77018**

**ELECTRONIC ORGAN KITS, KEYBOARDS** for music synthesizers and organs. Independent and divider tone generators, diode keyer systems. I. C. circuitry. Many components. 25¢ for catalog. **DEVTRONIX ORGAN PRODUCTS, Dept. B, 5872 Amapola Drive, San Jose, Calif. 95129**

### BUSINESS OPPORTUNITIES

**START SMALL HIGHLY PROFITABLE ELECTRONIC PRODUCTION IN YOUR BASEMENT.** Investment, knowledge unnecessary. Postcard brings facts. **BARTA-REI, Box 248, Walnut Creek, Calif. 94597**

### TUBES

**RECEIVING & industrial tubes, transistors.** All brands—Biggest discounts. Technicians, hobbyists, experimenters—Request free giant catalog and save! **ZALYTRON, 469 Jericho Turnpike, Mineola, N.Y. 11501**

**DIGITRON** display tubes 8 seg. 3/16"x5/16". Used but usable for experimenters. Free hook-up schematics included. 5/\$6.00, 10/\$11.00 postpaid. Send check or money order only. **UNICOM SYSTEMS, 10670 N. Tantau, Cupertino, Calif. 95014**

**RADIO and TV tubes 36¢ each.** One year guaranteed. Plus many unusual electronic bargains. Free catalog. **CORNELL 4217-E University, San Diego, Calif. 92105**

### REBUILD YOUR OWN PICTURE TUBES?

With Lakeside Industries precision equipment, you can rebuild any picture tube!

For complete details, send name, address, zip code to:

**LAKESIDE INDUSTRIES**  
3520 W. Fullerton Ave.  
Chicago, Ill. 60647  
Phone: 312-342-3399



**F.C.C. EXAM MANUAL**

The Original Test-Answers exam manual that prepares you at home for FCC First and Second class licenses. Includes Updated multiple choice tests and Schematic diagrams. PLUS Self-Study Ability Test. -- OMLT: \$9.95 Postpaid

COMMAND PRODUCTIONS P.O. BOX 26348 — E  
RADIO ENGINEERING DIVISION • SAN FRANCISCO, CALIF. 94126

### SCHOTTKY IC's

74500—.99	74S64—.99
74503—.99	74S73—1.95
74504—.99	74S74—1.75
74505—.99	74S107—1.95
74508—.99	74S108—1.95
74510—.99	74S112—1.95
74511—.99	74S113—1.95
74520—.99	74S114—1.95
74522—.99	74140—.99
74540—.99	74S153—1.95
74551—.99	74S157—1.95

### TRANSISTOR SPECIALS

2N965	PNP 6E TO-18	.15W	7V	.1A	300MHZ	40Ht	5/\$1.00
2N1605	NPN 6E TO-5	.15W	24V	.1A	14MHZ	125	5/\$1.00
2N2360	PNP 6E TO-33	.06W	20V	.05A		980	32 \$.50
2N5324	PNP 6E TO-3	60W	250V	10A		20	35 \$1.50
2N1015D	NPN SI TO-82	150W	200V	7.5A		.025	10 \$1.45
2N2015	NPN SI TO-36	150W	50V	10A		.012	26 \$.90
2N3584	NPN SI TO-66	35W	250V	2A		10	100 \$1.50
2N3055	NPN SI TO-3	115W	100V	15A		.01	50 \$1.00
2N3772	NPN SI TO-3	150W	60V	30A		.2	30 \$1.25
2N5296	NPN SI TO-220	36W	40V	4A		.8	60 \$.50
2N6109	PNP SI TO-220	36W	40V	4A		.8	60 \$.55
2N4898	PNP SI TO-66	25W	40V	4A		4	46 \$.60
MJ2251	NPN SI TO-66	10W	225V	.5A		10	40 \$.70

### PRINTED CIRCUIT BOARD

4 1/2"x6 1/2" double sided fiberglass board, 1/16" thick, unetched \$1.60 ea. 5/\$2.50

Dual photo ELECTRIC CELL a COMPLETE substrate circuit, with photo cells, transistors and resistors, used to shut off and on light sensitive circuits \$1.75

### MAN-3 LED READOUT \$2.95

**MAN-1 LED 5 Volt READOUTS \$4.50**

### Full Wave Bridges

PRV	2A	6A
200	.95	1.25
400	1.15	1.50
600	1.35	1.75

### NIXIE TUBES

Similar to Raytheon 8754 tubes, with socket & data sheet \$2.25 3/\$6.00

8223 field prog. ROM ..... \$8.00  
1101 256 bit RAM ..... \$4.00  
8225 64 bit read-write RAM .... \$4.95

2N3819 FET ..... \$5.00  
TIS43 UJT ..... \$5.00

### VERIPAX PC BOARD

This board is a 1/16" single sided paper epoxy board, 4 1/2"x6 1/2" (standard veripax), DRILLED and ETCHED which will hold up to 21-14 pin IC's or 8, 16 or LSI DIP IC's with busses for power supply connections. It is also etched for a 22 pin connector. \$5.25 3/14.50

**DECADE COUNTER KIT**  
CONSISTING OF:  
1—NIXIE TUBE and SOCKET  
1—7490 1—7475 1—7441  
Special priced at \$5.50

### TTL IC SERIES

7400—.25	7476—.60
7401—.25	7480—.65
7402—.25	7481—1.25
7403—.25	7483—1.25
7404—.28	7486—.60
7408—.25	7490—1.00
7410—.25	7492—.79
7416—.48	7493—.79
7420—.25	7495—.90
7430—.25	74107—.60
7440—.25	74121—.70
7441—1.30	74141—1.35
7442—1.50	74154—1.95
7446—1.50	74161—1.79
7447—1.50	74152—1.75
7448—1.25	74193—1.75
7450—.25	74194—2.35
7460—.25	8570—1.90
7472—.40	8590—1.90
7473—.75	9309—1.95
7474—.50	9312—1.95
7475—1.00	9322—1.95

**ER900 TRIGGER DIODES.** These bidirectional trigger diodes are one of the best and cheapest methods to trigger SCR's and triacs .4/\$1.00

FLV 100 Visible LED ..... \$.65

ME-4 IR LED ..... \$.65

MRD 14B photo darlings ..... \$.65

3/4" reed switch ..... 6/\$1.00

1N4886 25-40W Power varactor ..... \$4.95

### TRIACS

PRV	1A	10A	15A	20A
100	.30	.60	.85	1.05
200	.65	.85	1.25	1.45
300	.75	1.10	1.45	1.65
400	.90	1.35	1.75	1.90
500	1.20	1.50	2.50	2.20

\*Press fit

Send 20¢ for our Spring catalog featuring Transistors and Rectifiers; 325 Elm St., Cambridge, Mass.

14 Pin DIP sockets ..... 3/\$1.00

16 Pin DIP sockets ..... .60

**TEN TURN TRIM POTS**

500ohm, 10K, 20K, 25K

50K ..... \$.75 3/\$2.00

### Silicon Power Rectifiers

PRV	1A	3A	12A	50A
100	.06	.09	.24	.90
200	.07	.12	.20	1.25
400	.09	.16	.35	1.50
600	.11	.20	.50	1.80
800	.15	.28	.70	2.30
1000	.20	.35	.90	2.75

### LINEAR CIRCUITS

PA234 1W audio ampl .	\$1.25
PA264—5 Watt regulator	\$1.25
LM309K 5V 1A regulator	\$2.25
SE 501 Video Amp ....	\$1.00
531 High slew oper amp	\$2.50
536 FET input oper amp	\$3.95
537 Precision 741 .....	\$2.50
540 70W Power driver ..	\$2.04
555 2 us to 1 hour timer	\$1.19
560 phase lock loop ...	\$3.25
561 phase lock loop ...	\$3.25
565 phase lock loop ...	\$3.35
566 Function gen .....	\$3.25
567 Tone decoder .....	\$3.25
703 RF—IF amplifier ...	\$.80
Dual 709 .....	\$.95
709C operational Amp ..	\$.39
723 Regulator .....	\$.75
741 operational Amp ..	\$.39
747 Dual 741 .....	\$1.25
748 Adjust 741 .....	\$.44
TVR 2002 high power	
723 .....	\$1.00
CA3065 FM/TV amp ....	\$1.35
5558 dual 741 (mini-DIP) .....	\$.88
LM 308 oper amp .....	\$2.95

### Silicon Control Rectifiers

PRV	6A	10A	20A	70A
50	.25	.32		
100	.30	.45	1.00	3.50
200	.50	.75	1.25	6.50
300	.60	.90	1.50	
400	.70	1.10	1.75	9.50
500	.80	1.25	2.00	
600	.90	1.40	2.25	11.00

Terms: FOB Cambridge, Mass. Send check or Money Order. Include Postage. Average Wt. per package 1/2 lb. No. C.O.D.'s. Minimum Order \$3.00



**SOLID STATE SALES**  
Post Office Box 74D Somerville, Mass. 02143 Tel. (617) 547-4005

Circle 105 on reader service card



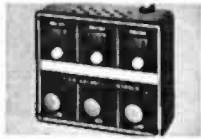
LIVE IN THE WORLD OF TOMORROW... TODAY! NEW PRODUCTS, NEW MATERIALS, NEW IDEAS!

# UNUSUAL ECOLOGICAL SCIENCE BUYS

UNIQUE HARD-TO-FIND BARGAINS FOR FUN, STUDY OR PROFIT



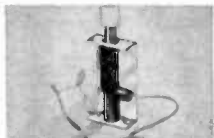
### 3-CHANNEL COLOR ORGAN KIT



Easy to build low-cost kit needs no technical knowledge. Completed unit has 3 bands of audio frequencies to modulate 3 independent strings of colored lamps (i.e. "lows"-reds, "midles"-greens, "highs"-blues. Just connect hi-fi, radio, power lamp etc. & plug ea. lamp string into own channel (max. 300w ea.). Kit features 3 neon indicators, color intensity controls, controlled individ SCR circuits isolation transformer; custom plastic housing; instr.

Stock No. 41,831EH ..... \$13.75 Ppd.

### 15,000 VOLT PUSHBUTTON



Piezoelectric Demonstrator Kit produces unlimited number of big 1/4" sparks. Pushbutton speed. Safely ignites gas flames, stoves, welding equip'l., trigger flash, strobe units, 5" high spark generator, wire w/ push-on terminals, small neon lamp make simple low-cost demonstrator for electric production by piezoelectric effect. Great for schools, labs, experimenters. Permanent camp & trailer stove-starter. Instrs.

Stock No. 41,723EH ..... \$5.30 Ppd.

### ULTRA LOW PRESSURE SENSOR



Big surplus bargain—tiny electrical pressure switch activated by only 0.02 psi air or 1/2" or less water pressure. Single pole, normally open. 10 ma DC contact rating. 30v AC/DC (usual loads require sensitive relay or solid state control). Use as sensor, switch, control counter, edge guide, instrument alarm. Long life (1,000,000 operations), impervious to shock, vibration. 1" sq. polycarbonate case, 3/16" diam. barbed pressure ports. Wt—10 grams. ORIGINAL COST \$11.50.

Stock No. 41,623EH ..... \$3.95 Ppd.

### FEATHERWEIGHT TREASURE FINDER



Best, easiest to use solid state metal detector at its price. U.S. made! Only 3 lbs! 8" head detects penny at depth of 5", silver dollar at 8", bag of coins at 18". Works thru dirt, sand, wood, water (30" deep), rock with no power loss. Detects "find" with "sound off" loud-speaker. Ready to go. One tuner control; all trans.; adjus stem; perfect balance. Incl 9v batt, FREE TREASURE GUIDE TO 101 Treasure Sites.

Stock No. 80,173EH ..... \$39.95 Ppd.

### NEW! ELECTRONIC DIGITAL COMPUTER KIT!



Solve problems, play games, predict weather with this actual working model of giant electronic brains. Amazing new fun way to learn all about computer programming... logic, decimal, binary systems. Laws of Sets—even do your own programming after completing simplified 116 page step-by-step assembly diag. Instructive booklet. Includes circuit panel, 2 "D" batt. (not incl.). Best model—for home, school, industry.

Stock No. 71,434EH ..... (11" x 12 1/2" x 4") ..... \$31.50 Ppd.

## MAIL COUPON FOR GIANT FREE CATALOG!

164 PAGES • MORE THAN 4,000 UNUSUAL BARGAINS

Completely new 1973 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. Many surplus items.

EDMUND SCIENTIFIC CO.  
Barrington, N.J. 08007  
Please rush Free Giant Catalog "EH"

Name \_\_\_\_\_

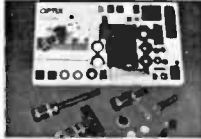
Address \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_

Zip \_\_\_\_\_

### 130 EXPERIMENTS IN OPTICS... PHOTOGRAPHY



Optix® Experiments Kit is a complete optical & photography lab for 130 exciting experiments. Lets you recreate the periscope, telescope, microscope, kaleidoscope! Build a 35mm reflex camera with interchangeable lens system! Make, develop photographic film! Enjoy the fun and fascination of having your own optics lab. Fully illustrated 112-pg manual, 8 1/2" x 11", clearly explains usage of this stimulating kit's 114 precision engineered components.

Stock No. 71,846EH ..... \$21.00 Ppd.

### STOP THIEVES! ENGRAVE NOW!

Police urge you to join "Operation Identification", mark your valuables w/ soc. sec. or driver's license #, then register with police. Discourages home, business, car burglaries. Low cost tungsten-carbide tip 110v Electric Engraver, with control knob to adjust depth & width of cut, works easily on metal, glass, plastic, wood, steel, most hard surfaces. Incl 2 "Operation Identification" window stickers, 10 "Stop Thief" labels, instructions.

Stock No. 60,971EH ..... \$9.95 Ppd.

### TERRIFIC BUY IN HE-NE LASERS



Low price on 0.5mW Laser (random mode); 0.9mm beam dia. (at 10M, 16mm) bellies its quality. New cold aluminum cathode tube for more life stability (at beam: 9000-hr tube life under normal cond.) Ready to plug in, turn on. Starts instantly. Safe, easy for holography, interferometry, alignment. Metal case, 2.8 x 3.8 x 10", 110v AC, 633nm wavelength, small beam divergence.

Stock No. 79,020EH ..... \$8.50 Ppd.

0.7mW (SINGLE TEMoMODE), 0.8mm BEAM DIA. Stock No. 79,024EH ..... \$9.50 Ppd.

### SLIDE-SHOW "BRAIN & VOICE"

Show/Order, with built-in slide-show synchronizer, is a cassette recorder too. One unit! On-site recording! Unique controls focus, activate (twice) cycles on projector. Digital counter to index; individ. channel eraseability; monitor switch to project external sound thru spkr; record music, narration at same time. 10-level vol. control. AC/DC. Incl. cable for Kodak Carousel® patch cord (radio, hi-fi), earphone, remote mike, blank cassette. 4 "C" batt., instrs.

Stock No. 71,619EH .. (9x8 1/2" x 2 1/2") .. (5 1/4" lb.) .. \$171.50 Ppd.

### FLEXIBLE IMAGE TRANSMITTER



Hi-resolution image-transmitter lets you see remote, inaccessible lighted areas; thru pipes, tubes, any 1/4" opening no matter how intricate. Provides clear, wide sighting. 7X magnifying eyepiece focuses from less than 1/2" away. Ideal for monitoring hazardous processes, surveillance instrs., 4,000 coherent glass fibers goose-neck sheathing.

Stock No. 60,857EH ..... \$40.00 Ppd.

### 3" ASTRONOMICAL TELESCOPE

See moon shots, orbit-stars, phases of Venus, planets close up. 60 to 180 power. New improved, aluminumized and overcoated 3" diameter 7/10 primary mirror, ventilated cell. Equatorial mount with locks on both axes. Equipped with 60x eyepiece and mounted Barlow lens. 3x finder telescope, hardwood tripod. Included FREE: "STAR HUNT": "HOW TO USE YOUR TELESCOPE"..... \$32.95 Ppd. Stock No. 85,050EH ..... DELUXE 3" ..... \$61.50 Ppd. Stock No. 85,105EH ..... 4 1/2" ..... \$99.50 FOB Stock No. 85,086EH ..... 6" ..... \$239.50 FOB



Stock No. 71,471EH ..... (3 1/2" x 4 1/2" x 6 3/4") ..... \$40.90 Ppd.

EXTRA 15-FT. TEMPERATURE PROBE ..... \$2.95 Ppd. Stock No. 41,839EH ..... \$2.95 Ppd.

### KNOW YOUR ALPHA FROM THETA!

Learn to control your Alpha-Theta brainwaves for relaxation, improved memory, concentration. Head electrodes, hooked to amplifier, filter brainwaves signaling audible beep for each Alpha-Theta wave passed. Wrist & finger contact pick up and amplify heart beat, skin resistance. Reliable, easy-to-use trainer unit offers features comparable to many higher-priced models. Completely safe. Most people can learn Alpha rhythm control in 10-12 hrs with full instructions included.

Stock No. 71,606EH ..... \$120.00 Ppd.

### STROBE SCREWS IN ANYWHERE

Self-contained Flashing Strobe unit w/Edison base easily screws into any standard socket! Great for parties, dramatizing displays, or safety signal to warn of indus. "hot" spots, constr. areas. Adj. slow flash rate from 0-1 flash per sec. (Does not stop action). Not as sophisticated as other strobes, but very handy & economical. Avg. life: 5 million flashes, 120v, 60 Hz. Approx 5x3" dia.

Stock No. 41,913EH ..... \$27.50 Ppd.

REPLACEMENT BULB, No. 41,918EH ..... \$4.75 Ppd.

### GET POLICE, AIRCRAFT CALLS

Your standard AM home or car radio can get exciting 2-way police, fire, local aircraft calls, etc. from UHF bands via Converters. No interconnecting wires needed—just put solid state Converter into your radio. Instrs incl. Ea. Kit req. 9v batt (not included). POLICE & FIRE CONVERTER KIT — LO BAND. Operates in the 30-50 MHz band. Stock No. 41,828EH ..... \$8.25 Ppd. AIRCRAFT CONVERTER KIT. Operates in the 108-136 MHz band. Stock No. 41,827EH ..... \$8.25 Ppd.

### MAKE PERFUME WITH A "STILL"

Real "flower power"—why pay like \$50 an ounce for perfumes when you can make your own in 5 simple steps? You supply the flowers, animal fat and undenatured alcohol (100-proof vodka is ideal)—kit contains all equipment needed for small quantities. Enjoy making exotic perfume from favorite garden flowers—even turn it into Cologne, hand lotion, after-shave lotion perfumed soap! Easy instructions. (Creative, fun hobby to turn a profit!)

Stock No. 71,684EH ..... \$10.75 Ppd.

### 1st LOW-COST VACUUM PUMP!

Nothing like it! Top-quality hand-held pump produces & maintains 25" of vacuum. Has instant release tab, 1 1/2" diam. stainless gauge (0-30"). 100's of uses—aluminum flange flasks, evacuate bell jars and castings, clean, retrieve, lift sterile objects, demonstrate Magdeburg hemispheres, bleed fuel lines, check leaks, etc. Lifts 40 lbs. with included "T" Lifter (2 1/2" diam. cup)—much more w/larger cup. Stock No. 71,301EH ..... \$12.00 Ppd. Stock No. 71,300EH (without gauge/lifter) ..... 5.50 Ppd.

### ASTRONOMICAL TELESCOPE KITS

Grind your own mirror for powerful telescopes. Kit contains fine annealed pyrex mirror blank, tool, abrasives, diagonal mirror, and eyepiece lenses. Instruments you build range in value from \$75.00 to hundreds of dollars. 4 1/2" diam. 3/4" thick. No. 70,003EH ..... \$10.75 Ppd. Stock No. 70,004EH ..... 6" diam. 1" thick \$16.95 Ppd. Stock No. 70,005EH ..... 8" diam. 1 1/2" thick \$24.50 Ppd. Stock No. 70,006EH 10" diam. 1 1/2" thick 30 lbs \$44.50 FOB Stock No. 70,007EH 12 1/2" diam 2 1/4" thick 46lbs \$72.50 FOB

### "FISH" WITH A MAGNET

Go treasure hunting on the bottom! Fascinating fun & sometimes profitable! Tie a line to our 5-lb. Magnet—drop it overboard in bay, river, lake or ocean. Trawl it along bottom—your "treasured" haul can be outboard motors, anchors, other metal valuables. 5-lb. Magnet is war surplus—Alnico V Type—Gov't. cost \$50. Lifts over 150 lbs. on land—much greater weights under water.

Stock No. 70,570EH ..... \$14.00 Ppd.

Stock No. 70,570EH 3 1/2" LBS ..... \$8.75 Ppd.

Stock No. 85,152EH 15 1/2" LBS ..... \$33.60 F.O.B.

# EDMUND SCIENTIFIC CO.

ORDER BY STOCK NUMBER • SEND CHECK OR MONEY ORDER • MONEY-BACK GUARANTEE

## 300 EDSCORP BLDG.

### BARRINGTON, NEW JERSEY 08007



*Pioneering again.....Castle presents a sensational NEW Timesaver for the Professional TV Service Technician..... Speed Testing by signal substitution. A new, simplified approach to signal circuit analyzing.....*

# **TV TUNER SUBBER™**



Transistorized Test Unit substitutes the tuner in defective TV Receiver to prove whether original tuner is good or bad. Performs tests normally made using elaborate and expensive signal generating equipment and oscilloscopes . . . but much more simply, with easily understood results. Tests that are, in fact, so simple that they can be made right in the home, in most cases without removing the tuner or chassis from cabinet.

Use with any 40MHz receiver . . . black and white or color . . . tube or transistor.

Completely self contained and battery operated; Mk. II, all solid state, improved version of original "subber." Uses L.E.D. indicator, has higher gain with wide range control affording more than 40db of gain reduction. Use on the bench or in the home . . . anywhere.

Substitutes the VHF tuner and tests the UHF tuner. Provides signal to simplify testing of tuner, i.f. system and AGC system. Comes complete with extension cables and instructions.

**Unsolicited praise bestowed this revolutionary device includes:**

*" . . . works good. I know it will save hours in my TV Service . . . you are to be commended . . ."*

*" . . . in one month . . . TV Tuner Subber . . . already paid for itself — twice! Thanks much!"*

*" . . . received only Ch. 5, and not good. Used the new Castle TV Tuner Subber and got all channels . . . original tuner removed for service!"*

**TV TUNER SUBBER MK. II net \$31.95**

Contact your distributor.

Include \$1.50 shipping and handling on prepaid mail orders: we will ship C.O.D.



**CASTLE TV TUNER SERVICE, INC.**

5715 N. Western Ave., Chicago, Illinois 60645 • Phone: (312) - 561-6354

# WINEGARD HAS PULL!

Pull enough to bring in those distant stations—those hard-to-get channels—pull enough to feed more than one set! Try Winegard's CW-980 Color-Wedge VHF-UHF-FM model, with its optional antenna-mounted solid state preamplifier, for the ultimate in TV reception.

Or, for strong-signal areas, try one of Winegard's smaller models. They offer the same high quality, the same protective gold finish, the same two-year replacement policy. If the Winegard name is on the box, you can be confident it's an antenna with real "pull"—and that's the name of the game!

## Winegard Antennas For Trailers and Boats



SR-20T

Specially designed SENSAR solid-state antenna for boats & recreational vehicles—extra strong construction.



HA-130

Winegard's new "Hideaway" Travel antenna for trailers, boats, campers, folds like an umbrella for travel!

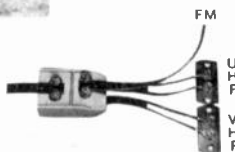
## Winegard Accessories For Complete Systems...



**BC-782 BOOSTER-COUPLER**  
Solid-State Booster-Couplers for all-channel TV and FM signals to 2 to 4 sets.

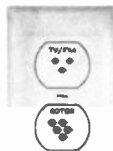


**CC-282 COUPLER**  
All-Channel non-amplified couplers to connect two sets to one antenna.



**CS-380 BAND SEPARATOR**  
Band separators to connect 75 or 300 ohm downlead to 300 ohm UHF, VHF & FM terminals.

**TR-35 TV OUTLET**  
TV outlets in a variety of models for all-channel TV and FM reception plus rotor.



**AC-823B CARTRIDGE PRE-AMPLIFIER**  
Antenna-mounted pre-amplifiers in 8 models for all-channel, UHF, VHF-FM and FM use, each in its own weather-proof housing.



**WINEGARD**  
TELEVISION SYSTEMS

Winegard Company — 3000 Kirkwood Street • Burlington, Iowa 52601

Circle 97 on reader service card