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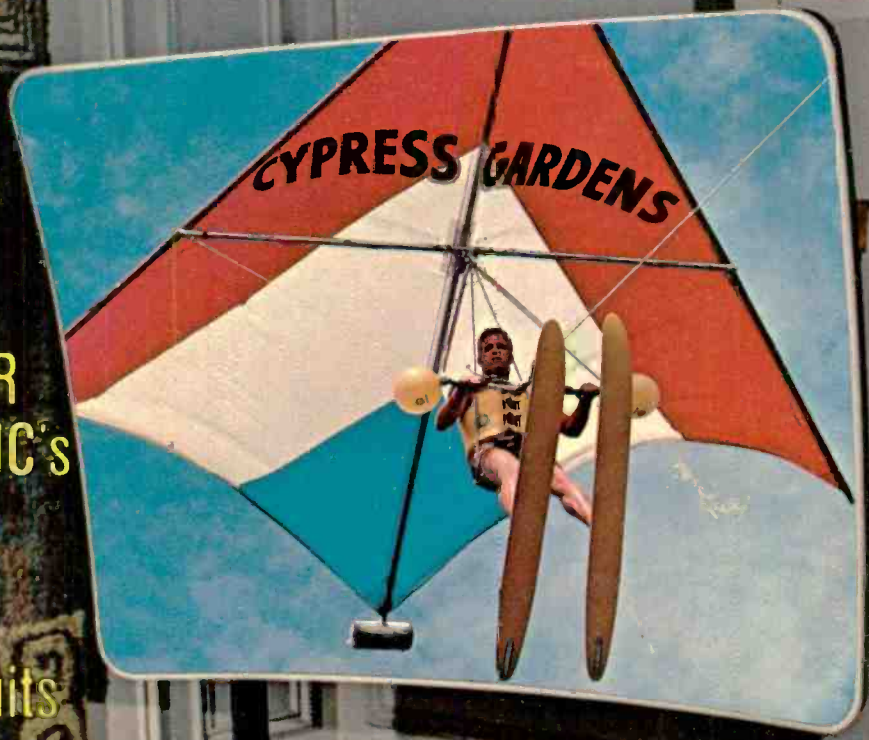

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...turn to page 33 for complete details

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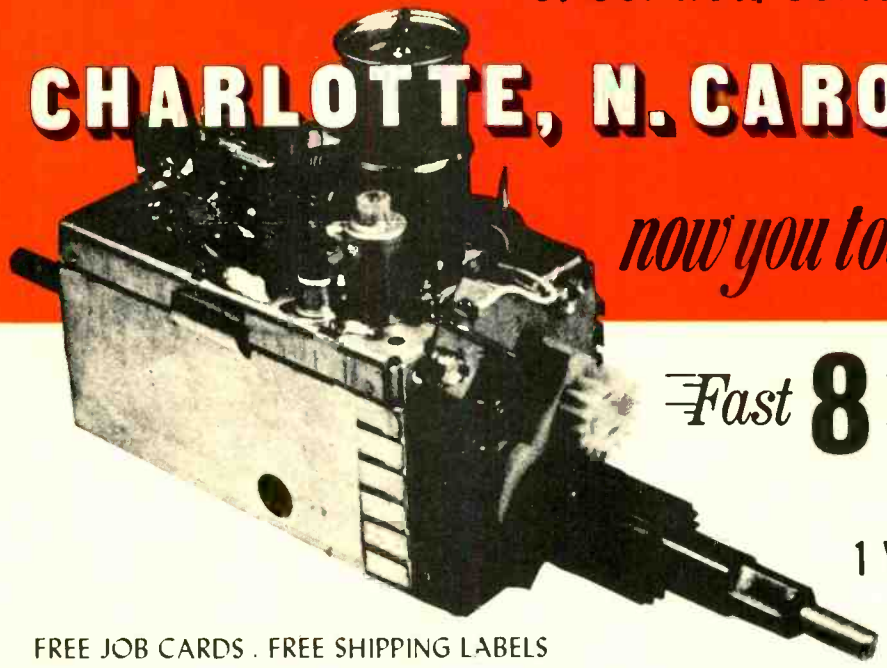

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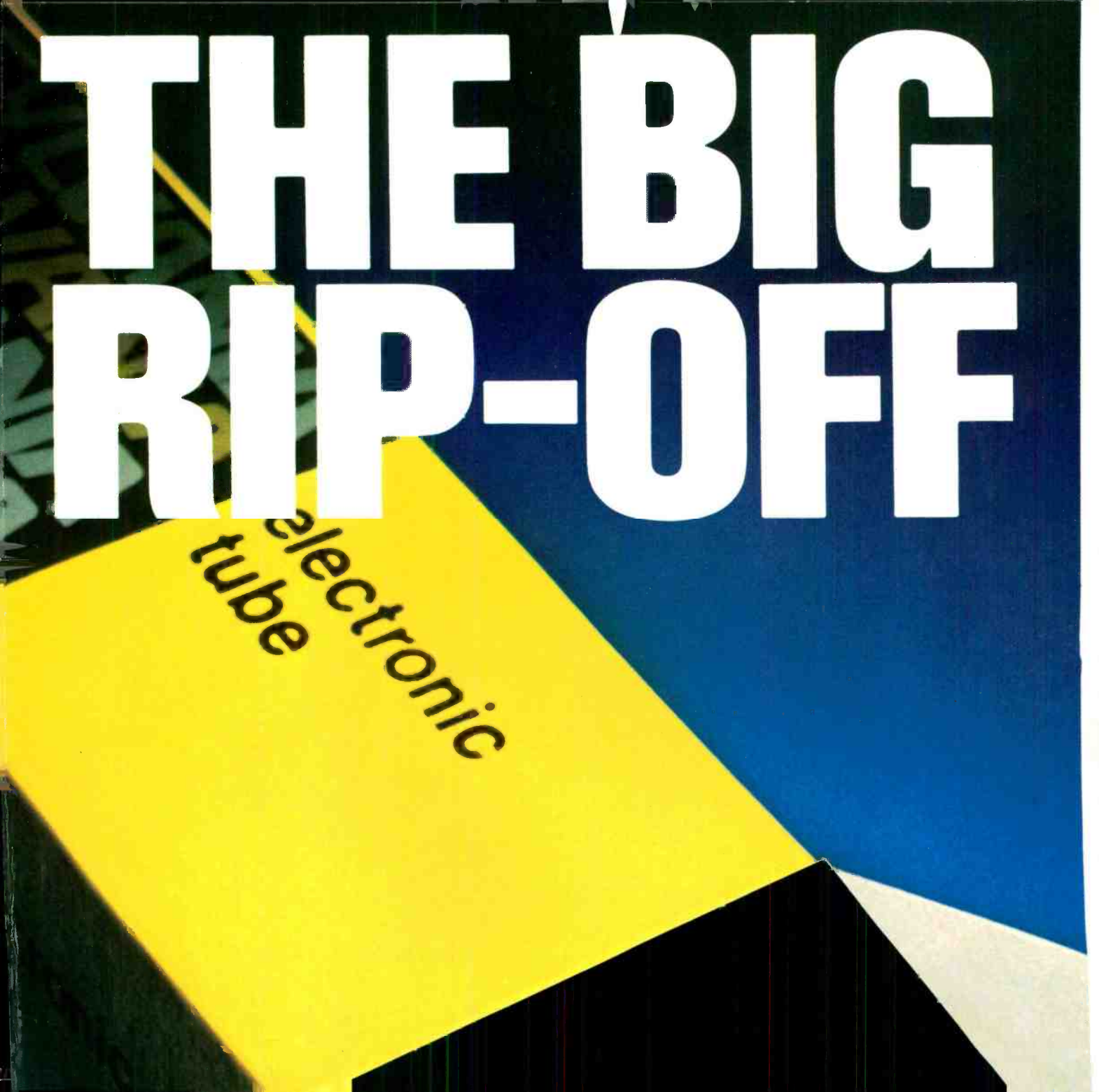







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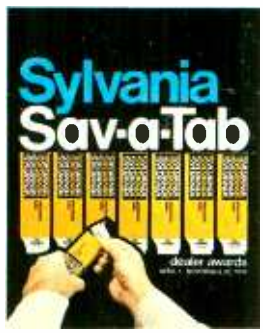

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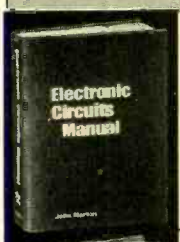

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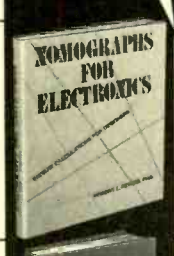

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ON THE COVER

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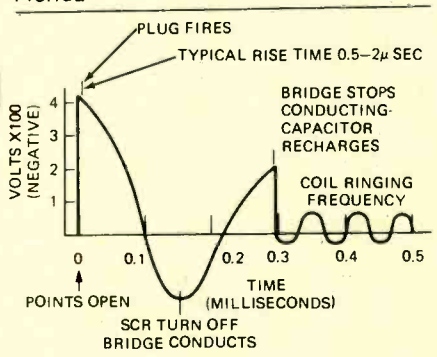
Photograph on the screen courtesy of Cypress Gardens, Cypress Gardens, Florida



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guest editorial

How will the energy crisis effect the electronics service and/or sales and service businesses? What will be the impact on the small- and medium-sized independent electronics service and sales dealer or the service-only electronic business? Will the way you conduct your business have to be suddenly changed to survive? Will it reduce your income or effect your business potential? Will your present actions and thinking have to be altered? No crystal ball gazer has all the answers, but let's look at some of the more important facts that stand out.

Yes! You will have to change your way of doing business and alter your methods of life. It will be *GOOD* for the independents who are positive-thinking, flexible-minded optimists; *DISASTROUS* for the fault-finding, inflexible-minded, negative-thinking person who can't see definite and sudden changes necessary in the market place and way of life brought on by the energy crisis and the impending metal shortages.

The energy crisis may be a blessing in disguise for the consumer electronics industry. It can be the best thing that has happened to the electronics industry since the introduction of television to the consumer. One only has to think positive for the advantages to come into focus in one's mind and also to see its drawbacks and future problems it has created. Let's go back to the depression era of the 1930's. Then people went hungry and children barefoot to save enough money to have the radio repaired or buy a new one. Radio (electronics) was then the main form of entertainment for the average family or the individual listening to Will Rogers, Amos and Andy and other famous entertainers. Today, thanks to the energy crisis, history may repeat itself. Today's consumer electronic products —radios, televisions, audio components, recorders and related equipment will return as the predominant form of entertainment for the family.

Today the energy crisis offers the greatest challenges and opportunities, since the introduction of television to the small- and medium-sized independent electronic businesses. The opportunities are very real and the possibilities for business growth and profit tremendous for the independent service dealer or sales and service dealer. The advantages, circumstances and conditions are most favorable for independents to better serve the electronic needs of the consumer and better represent the manufacturers. There has never been better conditions than now exist. This could be the last great opportunity for the independent electronic dealers, be it sales or service. The opportunities for growth and profit are waiting to be collected by the alert, progressive, positive-acting, positive-thinking, forward-visioned, association-oriented independent electronics business owner or manager.

The independent electronic businesses are now at the fork in the road in the business jungle. *One branch leads to survival, the other leads to disaster.*

Let's take the SURVIVAL branch and see what is necessary to gain passage down the exciting highway.

One of the most important is to be able to see that a dramatic change is going to take place in the market place and your way of life because of the energy crisis and impending metal shortages. This means for you to use forward vision and an open flexible mind.

Be ready and willing to gladly accept these new changes and make the best of them, for in every adversity, there is a seed of good, or in every defeat there is a victory.

Be ready to "clean house so to speak" in overall operation of your business. Put it in order in appearance, in and out, clean up, paint up or fix up the vehicles. Dress up your salesmen and technicians. Do professional invoicing. Improve telephone answering techniques, one of your most valuable assets. Above all treat each customer as if they are the only customer. Learn to listen intensely to each customer's complaint and assure them that you are doing everything possible to satisfy them. *Be willing to go that extra mile,* it will pay big dividends to you.

TIME is one of your most important assets. Learn to use it efficiently and effectively. Time lost can never be recovered, which means lost money.

If not a member of or involved in association action, promise today to join the local, state and national level. If a local or regional association is not available in your local area, then start one. If your state is one of the few without an association, be the driving force to get one started.

PROMISE TODAY to unite with and get involved with your associates (competitors) in association work at all levels; local, state and national. Help do your part to help the small businesses to win the survival struggle.

The independents, in unity, must pledge to better serve the consumer, better represent the manufacturers and to assist each other in true fellowship, interest and understanding.

Through an association you can learn to be a better businessman. Become a better professional electronics technician. You can group-run advertisements, get more exposure to the consumer at less dollar cost to your business.

Parts shortages. The association could set up an interchange of parts when the suppliers are out, so you can give faster service to the consumer. It is impossible in this writing to list even part of the helps for each other than can be had in associations that are positive acting. The association must have imagination and innovate ideas to put dreams into reality.

Each business manager, owner and technician must be his own worst critic and SELF ANALYZE HIS OWN PROBLEMS, or better yet, get an associate or member of the association to grade each other. Then take immediate measures.

Become involved in your community. Become a true professional businessman or a professional electronics technician in your community. You will be proud you did.

Pledge today after you join your local, state and national association to invite an associate (competitor) out to lunch. You will find him a fine person, who has many of the same problems you have and wants out of life the same things you may want. You will be proud you did and he will be glad you did. Then he can do the same thing with some other associate. This is the best way for unity. The decision for survival is yours.

Be loyal to your distributor and manufacturers who are loyal to you. Remember many distributors and small manufacturers are struggling for survival too. Loyalty has to be a two-way street. Don't try to handle too many lines or have too many suppliers for your volume of business. Look out for those who look out for you. This area badly needs improvement at the dealer and supplier level. Let the dealers lead the way by showing appreciation and loyalty to those who you know are loyal to you. Consider not doing business with those who only want your buck.

Be proud, you are a part of this ever-changing, exciting field of electronics. Walk, talk, dress, act, look and think professionalism in all you do. Do it today. Tomorrow is too late.

Join the team. Be a part of the team and do your share. The Miami Dolphins, under Don Shula, is a great team because each player does his best for the team to win, not for his own personal glory. If the independents will join into one great team and each do his best for the team to win, the independents will win this battle.

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looking ahead

For the consumer

Here in Hong Kong, one can get some idea of the status of China's consumer electronics by shopping the department stores specializing in mainland Chinese products. A few tube-type table radios —multi-band, with European styling—are still on display, but solid-state equipment seems to be taking over, and the new styles resemble American and Japanese design. Prices of the equipment are relatively low—at least in Hong Kong. A six-transistor pocket radio is $5.60. A Pearl River brand personal portable with medium and short-wave bands sells for $14.40, and a similar set labeled Spring Thunder is $16.10, with an eight-transistor Red Lantern three-band set at $21.40.

The only stereo equipment observed was a tube-type amplifier at $43, but two mono receivers (medium and long wave) were solid-state and tagged as $76 and $96.

Tickless tick-tocks

The first common, everyday product to undergo a complete revolution via electronics most likely will be the timepiece. The electronic watch currently is a mark of distinction on the wrist of the wearer, but the everyday mechanical type seems to be headed for early extinction, thanks to IC's and miniature display systems. A new study, by Quantum Science, predicts that nearly a million all-electronic digital watches will be produced this year, up from just 180,000 in 1973, and that the cost of making such a watch should drop to about $20 by the end of this year, as compared with $35 last year. By 1980, the study forecasts, they'll cost about six dollars to make—and more than 115,000,000 will be sold.

Electronics, incidentally, has turned the watch business upside-down. In the 1950's and 1960's, American watchmakers virtually gave up on domestic production. Unable to compete with the Swiss, almost all of them were forced to import Swiss movements, which they inserted in American-made cases. Now the pendulum (if that's still an appropriate word) has swung. To keep up with the changing times, Swiss watchmakers are now buying American electronic watch movements (that word itself is an anachronism to describe something with no moving parts) and putting them in Swiss-made cases!

Homefax again

Before the dawning of the television age, there was considerable fanfare about home facsimile services. Shortly after World War II, there were major experiments in transmission of newspapers to homes via fax. Then along came TV and fax was put on the back burner.

Now homefax is being talked up again—this time in connection with the "home data terminal" to be made possible through broadband two-way cable systems connecting America's homes and businesses. There are still many problems—including the development of a hard-copy printing system cheap and reliable enough to become a consumer product.

Electronic mail delivery to the home is now a major goal of forward planners in the cable industry. The prototype of one such system was recently demonstrated to officials of the Commerce Department and members of the staff of the Senate Committee on Postal Service by TelePrompTer, a major owner of cable TV systems.

Printout equipment for the system was developed by Repco Inc., Orlando, Fla., which plans to have the first 100 sample units ready for field testing this year. The printer is designed to be produced for $120 or less, to hold a month's supply of paper, with no expendable chemicals for processing. The prototype supplies printout on a roll of paper about 4 inches wide with a dot resolution of 64 per inch. It requires a bandwidth of about 50 KHz and provides legible printed copy as well as diagrams, handwriting, and so forth.

Instead of using a single stylus, it employs a line of stylii—one for each dot on a horizontal line—and can crank out legible printed matter at a rate of 30 words per second. The paper is electrosensitive.

The feasibility model is just one of many approaches to hard-copy readout for the home, and you can expect to see much more experimentation in the near future aimed at replacing the mailman with a cable.

Buying spree

Americans bought more color TV sets last year than in any previous year in history—nearly 9,300,000 of them. Add 7,000,000 monochrome sets and you get 16,300,000 television sets sold last year. To supply the demand, American manufacturers produced 8,672,000 color sets and importers supplied 1,399,000, for a total of more than 10 million color TV's built here or imported into this country. For black-and-white, the totals were 2,308,000 American-made sets and 4,989,000 imports, totaling 7,297,000. The grand total of sets made and imported in 1973—color plus monochrome—was 17,367,000, or about one new TV for every four American households.

The revaluation of the dollar in comparison to foreign currencies contributed to a resurgence of domestic color production. In 1973, more than 86% of color sets sold in the U.S. were made here, up about one percentage point from the 1972 figure. But monochrome was increasingly a foreign-made market. Better than 68% of black-and-white sets sold here last year came from overseas, up from less than 62% a year earlier.

Outlook dims

If last year was a hot one for the video-dough, this year's prospects don't seem so bright. Ferociously rising parts prices, consumer uncertainty and shortages all are expected to have a depressing effect for much of the remainder of this year. Manufacturers have to wait as long as a year or more for delivery of some types of semiconductors and capacitors, 34 weeks for resistors, 30 weeks for circuit boards, according to one industry survey.

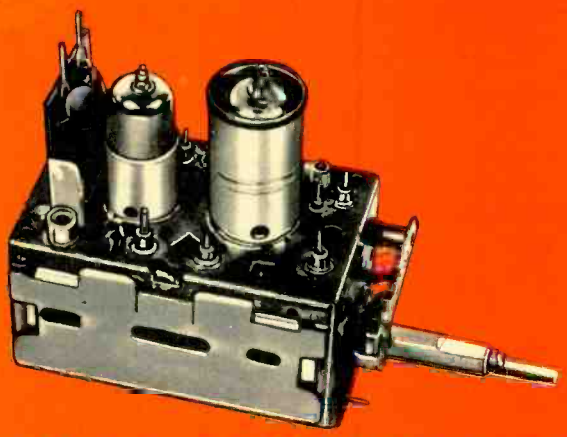
At the same time, costs of components and materials have been rising almost daily. In response, receiver manufacturers almost universally have increased their prices, some of them substantially —reversing the trend of many years toward lower and lower tags on TV sets. At press time, set makers were predicting a good-but-not-great year. But it could be a better year than usual for the TV service industry, as viewers have their sets repaired rather than buy new ones.

Electronic tuning

In Europe, almost all color sets—and many black-and-white ones—have all-electronic varactor tuning. Yet in the United States, varactor tuners are found in a relatively insignificant number of sets, almost all of them in the high price brackes. With fewer channels receivable in Europe, and greater spacing between channels, electronic tuning is simpler there than here. But American semiconductor manufacturers are optimistic that TV set makers here will flock to varactors soon, and some predict that the majority of new sets will be electronically controlled by 1977. Many of them are aiming at the development of an IC to take over the control and addressing function.

But mechanical tuning is still much cheaper than electronic—and until there's a real cost breakthrough set makers can be expected to opt for the clunk-clunk tuner for most of their lines. **R-E**

by DAVID LACHENBRUCH
CONTRIBUTING EDITOR



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except tubes and transistors

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

Fast efficient service at our conveniently located service centers. This price does not cover mutilated tuners.

All tuners are cleaned ultrasonically, repaired, realigned and air tested.

REPLACE

Universal Replacement Tuner $12.95 (in Canada $15.95)

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

All shafts have a maximum length of 10" which can be cut to 1½".

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

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Customized tuners are available at a cost of only $15.95. (With trade-in $13.95) (in Canada $17.95/$15.95)

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TEXAS	DALLAS, TEXAS 75218,	11540 Garland Rd.	Tel: 214-327-8413
VIRGINIA	NORFOLK, VIRGINIA 23502,	4538 E. Princess Anne Rd.	Tel: 804-855-2518-9955
CANADA	TUNER SERVICE CORP., QUEBEC	Write headquarters office for address.	

TSC

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Franchises available-Contact headquarters for information.

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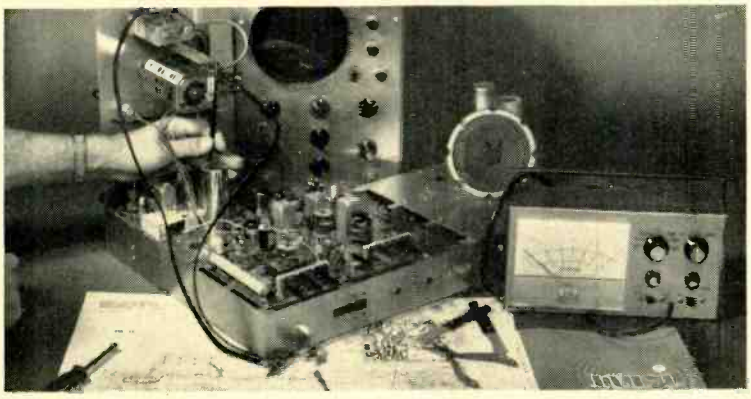
NOW train at home with NRI to be a Computer or Digital Technician– no other program is so complete in digital logic, computer operation and programming.

ANOTHER nri FIRST

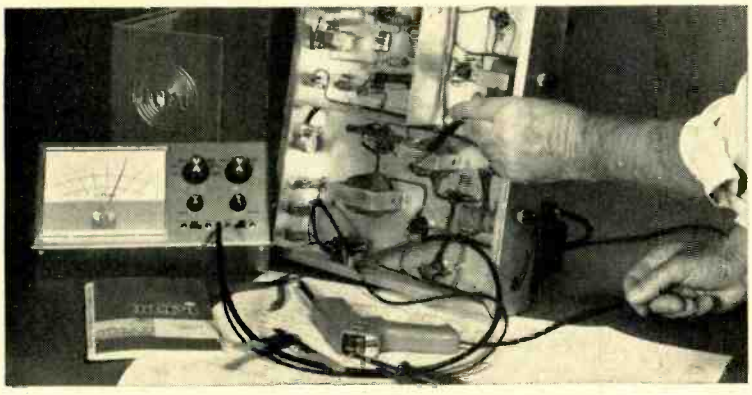
Your own digital computer included at no extra cost

This may very well be the most unique educational aid ever developed for home training—a *real* digital computer you build yourself and use to learn organization, operation, trouble shooting and programming. This remarkable training aid performs the same functions as bigger commercial computers. One of ten training kits you receive in the new NRI Complete Computer Electronics course.

NRI FIRSTS *make learning Electronics fast and fascinating—give you priceless confidence*



FIRST to give you Color TV training equipment engineered specifically for education—built to fit NRI instructional material, *not* a do-it-yourself hobby kit. The end product is a superb Color TV receiver that will give you and your family years of pleasure. You "open up and explore" the functions of each color circuit as you build.



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 trouble shooting become a matter of easily remembered logic.

FIRST to give you completely specialized training kits engineered for business, industrial and military Electronics Technology. Shown is your own training center in solid-state motor control and analog computer servo-mechanisms. Telemetering circuits, solid-state multivibrators and the latest types of integrated circuits are included in your course.

There is so much to tell you about this latest "first" in home training from NRI, you must fill in and mail the postage-free card today to get the full story of the Complete Computer Electronics course and the amazing digital computer you build and use as you learn.

Planned from the start to include specially designed training equipment in the pioneering NRI tradition, this exceptional new course succeeds in combining kits with NRI "bite-sized" texts to give you an easy-to-understand educational package. But, unlike other home training, this is not a general electronics course. Lessons have been specifically written to stress computer repair. You perform a hundred experiments, you build hundreds of circuits. Included are over 50 modern, dual-in-line TTL integrated circuits you use in the construction of your computer. You use professional test equipment. In addition to your digital computer, you build and use your own solid-state voltohmmeter and oscilloscope. Because you work with your hands as well as your head, your training is as much *fun* as it is education.

Train with the leader—NRI

As it has in other fields of home-study Electronics training, NRI has taken the leadership in computer training because the "Computer Age" continues to leap ahead. Qualified men are urgently needed, not only as digital technicians and field service representatives, but also for work on data acquisition systems in such fascinating fields as telemetry, meteorology and pollution control. Office equipment and test instruments also demand the skills of the digital technician. Like other NRI courses, this exciting new program can give you the priceless confidence you seek to walk into a technician's job and know just what to do and how to do it. Mail the postage-free card for the FREE NRI Catalog. No obligation. No salesman will call. NATIONAL RADIO INSTITUTE, Washington, D.C. 20016.

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new & timely

Optical readers check items in new supermarket checkout stand

Called by Sperry Univac "a revolution in food marketing," a new supermarket checkout system uses optical scanning to check items on the conveyor and a computer (for a line of stands) to translate codes on the checked items into prices, display them visually, and print out a customer tape.

The system uses a fixed laser beam optical reader to detect, read, and decode Universal Product Code (UPC) symbols on product containers or labels. The UPC symbols contain product information in the form of vertical bars in a ten-digit format. The code was adopted by the Grocery Industry of the United States in April, 1973. It is expected that nearly all supermarket items will come from the manufacturers preprinted with the UPC symbols by the end of 1975.

In a test at Kroger's Kenwood Shopping Center, Cincinnati, from July to October 1973, the Sperry Univac checkout handled all the needs of the 8000-customer-per-week store, increasing checker productivity about 45 per cent and increasing number of customers serviced from 15.7 to 23.1 per hour in one checkout lane. Average customer waiting time decreased 40 per cent and checkers made 75 per cent fewer mistakes. The system was operable 99.97 per cent of the time the store was open.

The Supermarket Checkout System can provide such special features as check verification and visual displays of product identification. It can calculate the price break on multiple-priced items, including mix-match sales; can handle credit functions like bottle returns, store coupons, refunds, and rain checks. It can also provide up-to-the-minute sales reports by checker, stand, department or store, and allows rapid repricing of items.

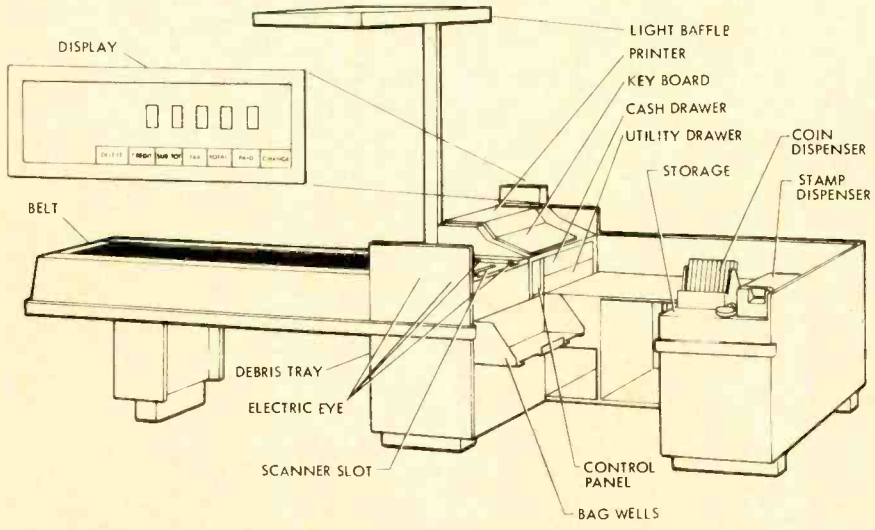
Satellites may relay solar energy to earth

Students at the University of Michigan have designed a small prototype satellite to test whether solar energy can be collected and transmitted to earth efficiently. The sun, they point out, is an inexhaustible source of power, capable of supplying enough energy to meet any crisis in the humanly foreseeable future. But whether there is any possible economic method of harnessing that energy is still a question.

Ground-based solar power installations have been made, usually in desert or near-desert areas. But solar energy is greatly weakened by passing through the atmosphere, only a little of it reaching the earth. Thus any large-scale terrestrial effort must use tremendous tracts of land in favorable geographic locations, and even in those places storage facilities must be provided for nights and cloudy weather.

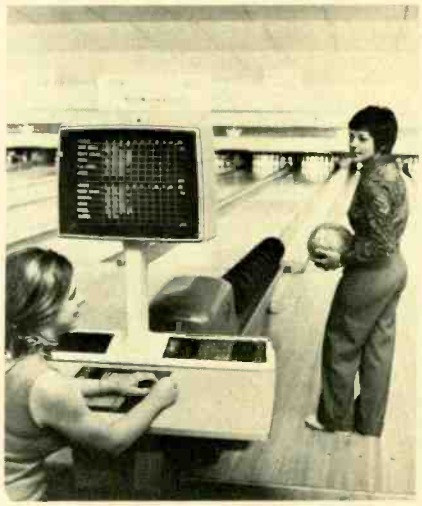
A Satellite Solar Power Station (SSPS), as conceived in the mid-'60's by Peter E. Glaser of Arthur D. Little, Inc., would receive full-strength energy from the sun 24 hours a day, overcoming the chief difficulties of ground-based stations. Each station would consist of one or more large satellites with huge panels for collecting solar energy. Each satellite would furnish 10,000 megawatts continuously, enough to supply a metropolitan area like that of New York City or Los Angeles. The stations would convert the solar energy to microwave beams focused on ground receiving stations, which would convert the microwave power to electric current of whatever voltage and frequency might be required for commercial distribution.

The prototype satellite that will test the practicability of the proposed system weighs 1093 pounds. It has two large square panels with a total area of 790 square feet, contains the necessary conversion equipment and mounts a 30-foot parabolic transmitting antenna. It will be able to transmit about 5 kilowatts of power. Already under development, it is expected to be ready for a 1978 launch.



SCHEMATIC OF NEW SPERRY RAND AUTOMATED ELECTRONIC CHECKSTAND

COMPUTER REACHES THE BOWLING LANES



AUTOMATIC BOWLING SCORING SYSTEM that senses fallen pins electronically and uses a small special-purpose computer to tally the score automatically is now in use in seven U.S. cities. RCA developed the system, which is sold by Rapid Score, subsidiary of Conbow Corp.

On stepping up to play, each bowler presses the button opposite to his or her name on the scoring table. This lights the player's name on the console. An electronic camera checks the number of pins left standing after the first bowl. The information is transmitted to the computer, an RCA *Fleximite*, at the console, and the score is recorded. If a strike was made (all pins down), the player's name goes out and a NEXT PLAYER sign is lighted. There is another display at the manager's office, where a print-out of any desired score—or all scores—may be had by pressing a button.

The photo shows the installation in the Lawrence Park Lanes, Broomall (near Philadelphia), Pa.

Largest solid-state image sensor uses charge coupling technique

A silicon chip about as big as a nickel is hailed as "a key milestone in the creation of a new generation of tubeless cameras." The sensor, a charge-coupled device (CCD) contains over 120,000 elements.

(continued on page 26)

No other 10 MHz oscilloscope gives you all this for $475

The TELEQUIPMENT D61 is a low priced 10 MHz dual trace oscilloscope with sweep rates up to 10 ns/div. It is ideally suited for students, technicians, and hobbyists.

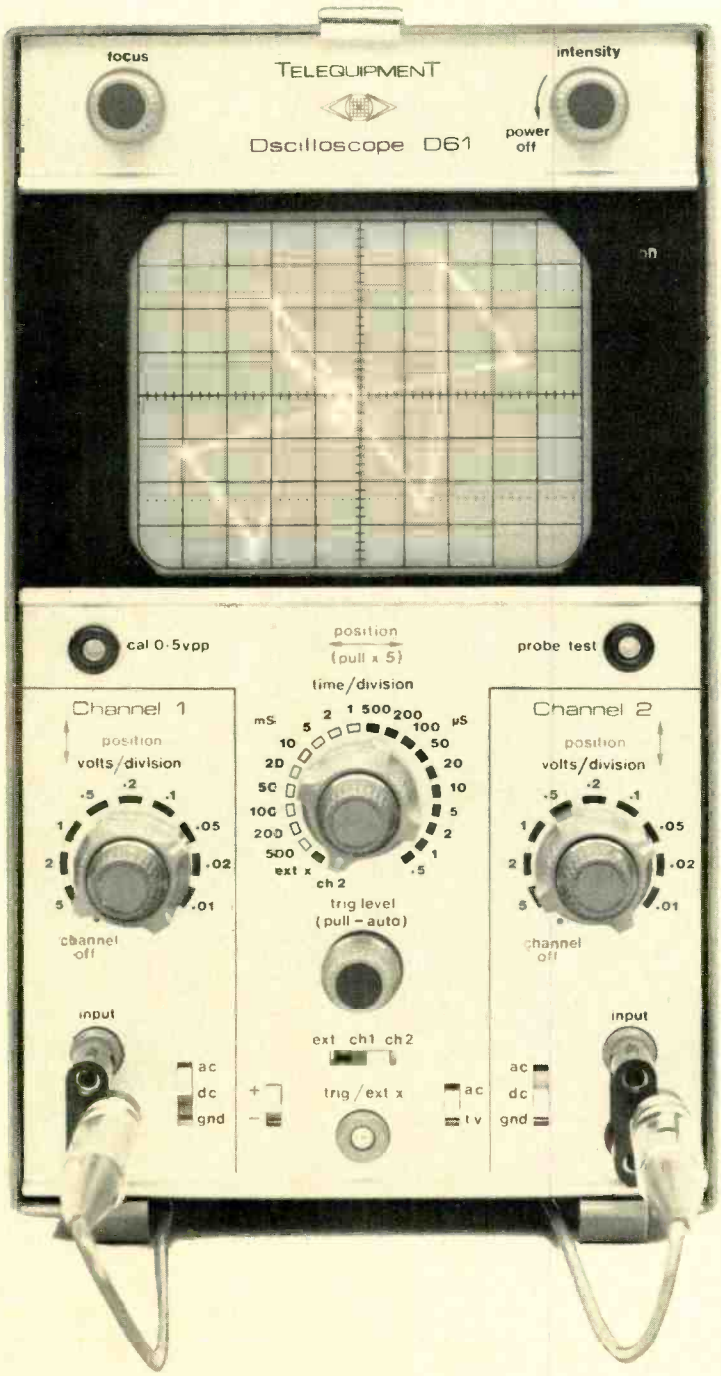
Operating Ease. Front panel controls are engineered for instant recognition. Line or frame displays are selected automatically in the TV trigger position. And, chopped or alternate modes are determined automatically to optimize display clarity.

Bright, stable viewing. Stable waveforms, displayed on an 8 x 10 cm crt, are easy to view, even under unfavorable ambient light conditions. Two identical input channels simplify generation of X-Y displays. This is particularly useful in analysis of vector patterns.

Application versatility. Because of its X-Y capability, the D61 simplifies alignment and troubleshooting of color television sets. Its performance equals or exceeds the requirements for servicing audio equipment, pocket calculators, public safety control, alarm, and communications systems, microwave ovens, digital clocks, and similar consumer electronic products.

Compact, portable. Fully transistorized, and weighing only 15 pounds, the D61 occupies only 6.3 inches of bench width. It's easy to transport and use in confined working areas.

Tektronix reliability. TELEQUIPMENT products carry the well-known Tektronix warranty and are marketed and supported by the Tektronix organization.



Automatic triggering. TV Frame and line triggering. Dual-trace, X-Y and vector modes.

☐ Send me the D61 Spec Sheet and Telequipment catalog.

☐ Have your field engineer call to arrange a demonstration.

Tektronix, Inc., P.O. Box 500, Beaverton, Oregon 97005

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TEKTRONIX®
committed to technical excellence

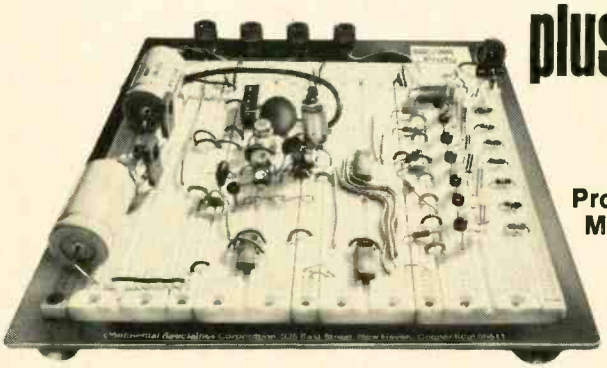
Circle 6 on reader service card

NEW! Build and test circuits as fast as you can think! No soldering or patch cords!

Plug in...wire...modify...build...test

without soldering for as little as $3.00

Flexible new Continental Specialties QT SOCKETS® and BUS STRIPS are a fast, easy breadboarding system with unique SNAP/LOCK that lets you add or remove as many QTs as you need instantly. Now you can test ICs, transistors, resistors, capacitors and more. Just plug in, and connect with solid #22 AWG hook up wire... no soldering is needed! No more shorts! No more burnt fingers! No special patch cords! And you can use QTs again and again! QTs come in different sizes, starting as low as $3 for QT Sockets and $2 for Bus Strips. Order yours today!



plus, four new completely assembled PROTO BOARDS...

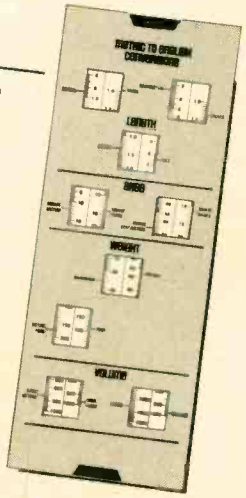
PAT. PENDING

Proto Board Model No.	14 Pin DIP Capacity	Size (L" x W")	Price (U.S. only)
101	10	5.8" x 4.5"	$29.95
102	12	7.0" x 4.5"	$39.95
103	24	9.0" x 6.0"	$59.95
104	32	9.5" x 8.0"	$79.95

Four new Continental Specialties Proto Boards, made from combinations of QT Sockets and Bus Strips let you make all circuit and power interconnections with common solid #22 wire, while power distribution busses make wiring a snap. Aluminum base plates offer solid work surfaces and perfect ground plane. Rubber feet prevent scratching. Each Proto Board features one or more 5-way binding posts to tie into system or power supply ground. All are compatible with ICs (digital or linear), in TO5s, DIP packs and discrete components. Each is assembled and ready-to-use.

Order today — or send for free selection guide, with applications, photos, specs and more.

FREE METRIC TO ENGLISH SLIDE RULE
Convert lengths, area, weight, volume instantly. Yours FREE with each Proto Board order!



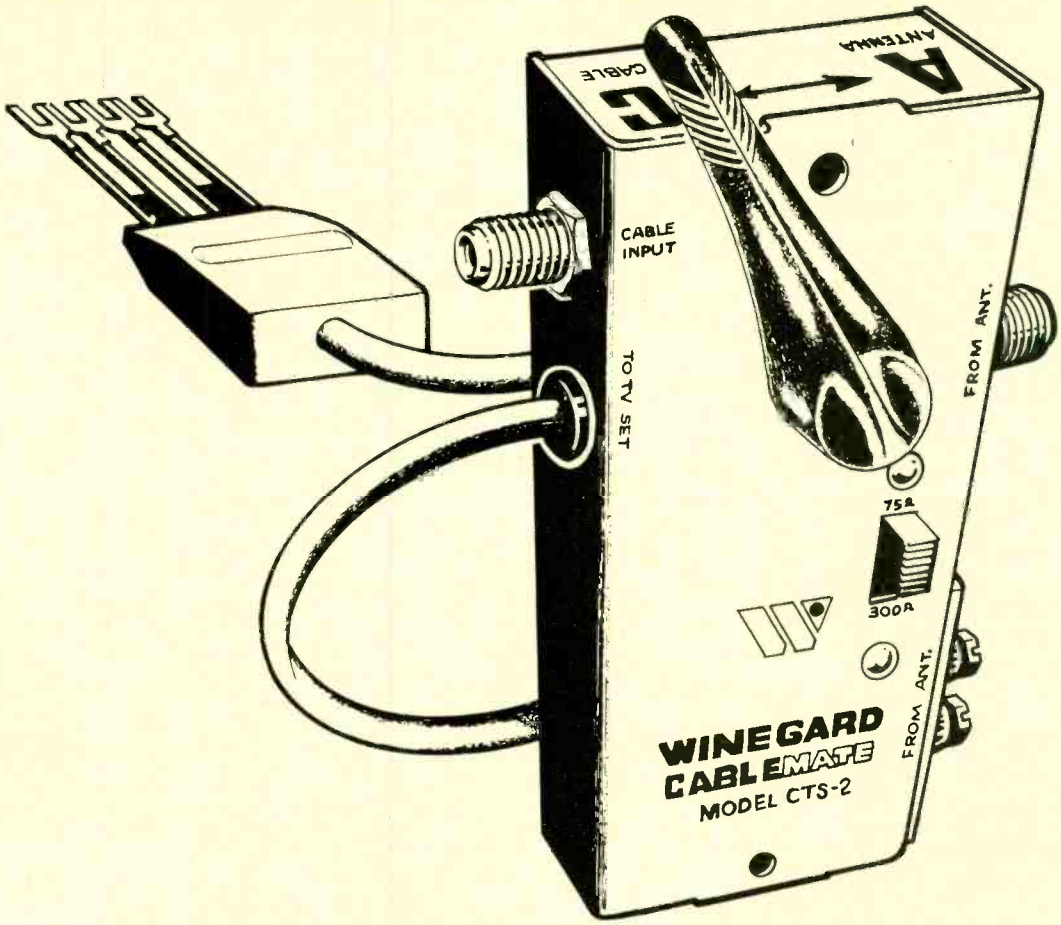
Continental Specialties Corp.
325 East St., Box 1942
New Haven, CT 06509
Telephone (203) 624-3103

CANADA: Available thru Len Finkler, Ltd., Downsview, Ontario

Charge it on your BankAmericard, American Express or Master Charge.

Circle 7 on reader service card

How to sell a TV antenna to a cable TV subscriber.



The new exclusive Winegard Cablemate TV Signal Selector lets your customers enjoy the advantages of both cable and TV antenna reception.

If there's cable TV in your area, a lot of your customers already have, or someday will have, a cable hookup. Most of them sign up to get long distance stations or local programming not possible with an outdoor antenna. At the same time, cable people claim that every subscriber will get better reception all the way around.

But the cable subscriber usually gets short-changed. He soon finds out that the channels he regularly watched with an outdoor antenna **don't** come in as clear on cable. And these are almost always the network stations, the ones people watch 90% of the time.

Technicians Frequently Get Blame

The problem of poor quality cable reception on one or more channels is a common one in city after city. Too often the TV technician is called for TV set repair when the cable is really at fault. Cable outages, too, are a frequent customer complaint.

That's where you come in. With a Winegard Cablemate TV Signal Selector and a Winegard outdoor antenna.

Cablemate lets you connect cable signal **and** the antenna signal to the TV receiver. The viewer simply flips a switch to select antenna or cable.

Not "Just Another Switch"

Cablemate, of course, is not an ordinary switch. It has specially designed circuitry with 58db isolation to prevent interference between cable and antenna signals. And it gives you a choice of coax or twinlead antenna input.

Customers Are Waiting For You

If your cable TV customer already has a good antenna on the roof, then all he needs is Cablemate. But if he has an inadequate antenna or none ar all, then he's a hot prospect for **both** an antenna and Cablemate. That's profitable business . . . and the easiest way yet to sell a TV antenna to a cable subscriber.

As you can tell, you stand to gain a lot from one switch! But then remember it comes from Winegard, the folks who consistently originate new and better products for the TV service industry.

MODEL CTS-2 (Illustrated):
$16.95 suggested list.
MODEL CTS-1 (same, but has 75 ohm and 300 ohm output to set and does not include coax or band separator): **$14.95** suggested list.

WINEGARD
TELEVISION SYSTEMS

Winegard Company • 3000 Kirkwood Street • Burlington, Iowa 52601

Circle 8 on reader service card

letters

THANK YOU!

RV/10-2 CB LEAGUE

Because of your vital interest in CB communications and equipment, we think that the enclosed will be of interest to you.

CB represents a valuable communications medium for the recreational vehicle owner because it provides him with safety on the road and a means to obtain vital road and campground information. If the channels continue to be clogged with illegalities and irregularities, such RV use will be seriously curtailed or impossible.

Accordingly, the RV 10-2 CB League was formed last August in an effort first to get the RV'er to clean up his own house and to use the channels properly. A monthly column in Woodall's Trailer Travel magazine keeps advising the RV'er how to use his CB correctly.

Recently, this League inaugurated a campaign to assist the FCC in its effort to clean up the CB channels, with the creation of the "Discrepancy Report" system. Copies of the DR are available from League Headquarters; permission to reprint can be easily obtained so long as credit to the League is given.

DR. KARL A. KOPETZKY
National Director
RV 10-2 CB League
500 Hyacinth Place
Highland Park, Ill. 60035

LEFT OUT EXAR

Upon receiving the current issue of **Radio-Electronics**, I was sadly disappointed by not finding Exar Integrated Systems, Inc. included in your list of manufacturers of electronic music components. Exar has seven different VCO's in their 2207 – 2307 line ranging in price from $3.75 to $20.25 in 1 to 24 unit quantities. These VCO's have four selectable inputs and triangle and squarewave outputs. Please also note that Exar carries a fine phase-locked loop and three dual 555 timing circuits ranging in price from $2.25 to $14.25 in 1 – 24 unit quantities.

THOMAS P. GREENE
Charleston, S.C.

Sorry for the oversight and our thanks for letting us know—Editor **R-E**

AD CORRECTION

In the Continental Specialties Corporation ad which appeared on page 70 in the March 1974 issue, an incorrect phone number was published. The correct phone number should be (203) - 624 - 3103.

MAIL COUPON TODAY

Please send me a Jerrold GIFTORAMA Catalog and one free GIFTORAMA Point.

Name _____

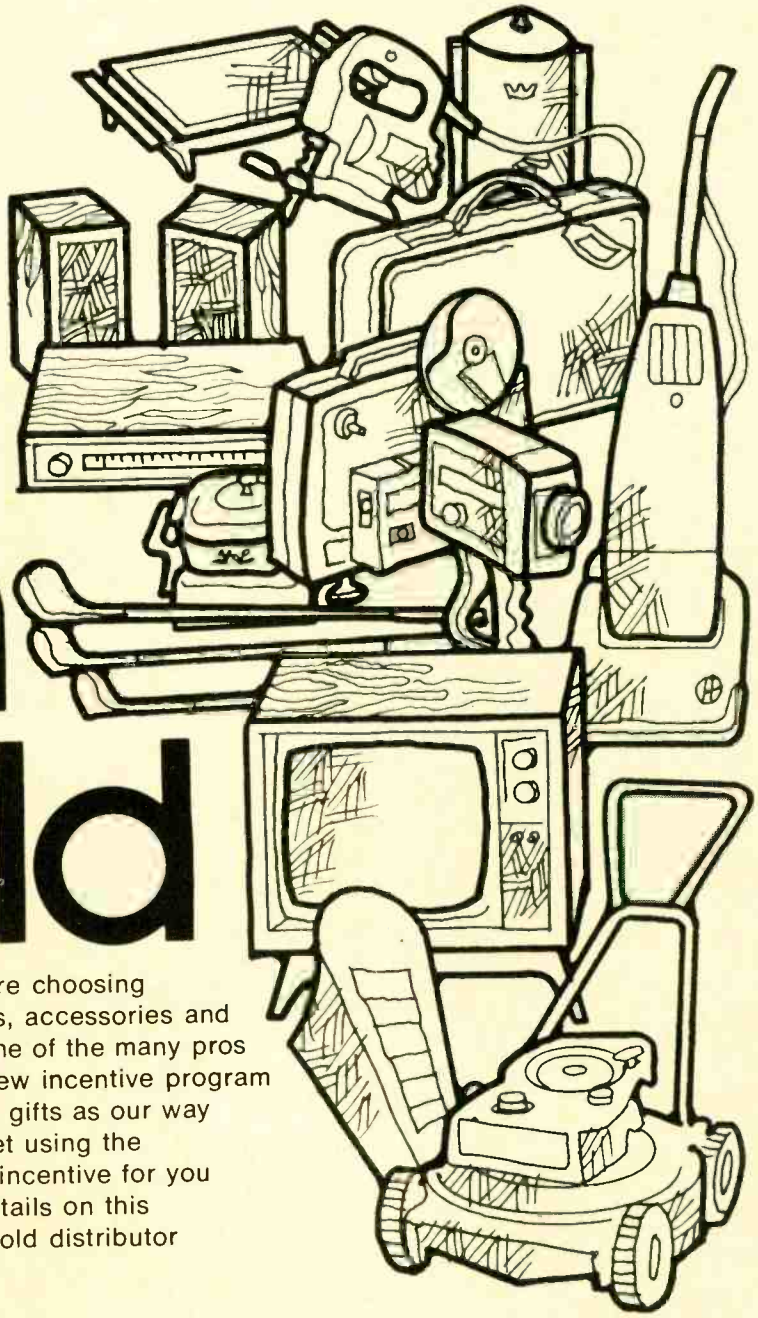
Address _____

City _____ State & Zip _____

Mail to: Jerrold Electronics Corporation
P.O. Box 350 • Horsham, Pa. 19044 RE-5

Professional Antenna Installers... cut yourself in on...

Free Gifts from Jerrold



More and more professional installers are choosing Jerrold top-rated antennas, preamplifiers, accessories and INSTANT MATV equipment. If you are one of the many pros using Jerrold equipment, this exciting new incentive program will give you the opportunity to gain free gifts as our way of saying "Thank You." If you are not yet using the Jerrold line, these premium gifts are an incentive for you to try Jerrold products. For complete details on this program, contact your participating Jerrold distributor or mail the above coupon today.

JERROLD Electronics Corporation • P.O. Box 350 • Horsham, Pa. 19044

a GENERAL INSTRUMENT company

Circle 11 on reader service card

The better the the better you'

And you can get started for just $10.

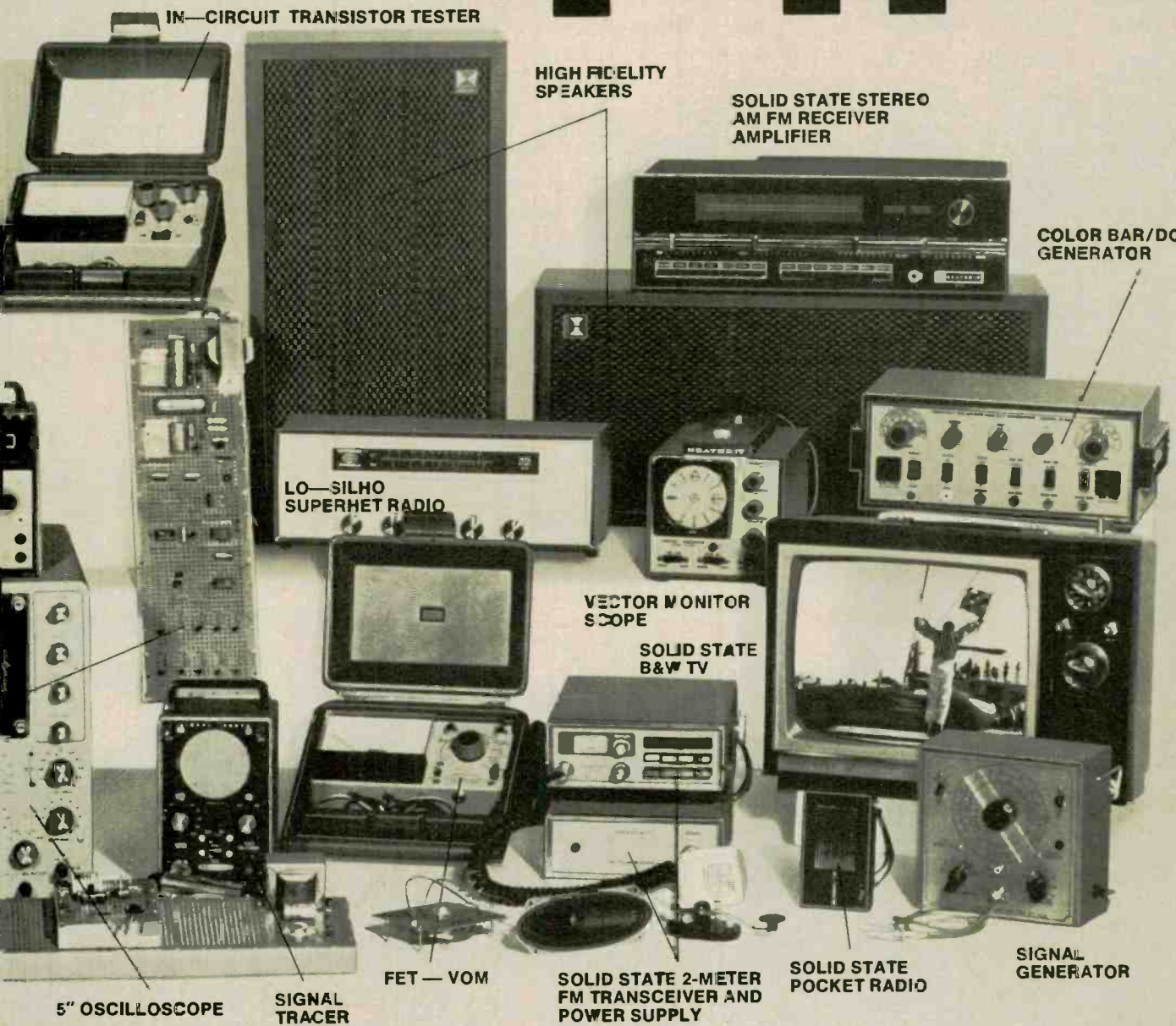
Only $10 down gets you into any NTS Home-Study Courses in Electronics.* Just $10 that can lead to a top-dollar job, a big, bright career in electronics.

As an NTS student, you'll acquire the experience and know-how that comes with first hand training on NTS "pro" equipment. Equipment you'll build and keep. Our courses include equipment like the 5" solid-state oscilloscope, a transistor and tube-tester, a vector monitor scope, 74 sq. in. B&W TV, or a solid-state stereo AM-FM receiver. The unique new **NTS Digital GR-2000 Color TV** with first-ever features like silent varactor diode tuning; digital channel selection, digital clock, an option at additional cost; and big 315 sq. in. ultra rectangular screen. This is just a sampling of the kind of better equipment that gets you better equipped for the electronics industry.

By following the easy-to-read NTS lessons, you learn the theory behind these tools of the trade. You'll learn and develop skill and confidence fast.

*Not including Advanced Color TV Servicing

equipment
l be equipped.



Choose from 12 NTS Electronics Courses, including Color TV and B&W TV Servicing, Electronics and Computer Technology, Electronics Communications & FCC, and Industrial & Automation Electronics. All courses can provide you excellent opportunities to expand your career in the exciting world of electronics! So get started right now by checking the coupon and mailing it today.

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 Veteran Training. Accredited Member: National Association of Trade & Technical Schools; National Home Study Council

NATIONAL TECHNICAL SCHOOLS

TECHNICAL-TRADE TRAINING SINCE 1905
Resident & Home Study Schools
4000 South Figueroa St., Los Angeles, Calif. 90037

equipment report

Leader LBO-302 Dual-Trace Triggered-Sweep Scope.

Circle 95 on reader service card

ONE OF THE THINGS YOU SHOULD ASK about any piece of test equipment is, "What can it do for me?" A dual-trace scope can do a lot, if you use it properly! For one thing, it will give you instant answers to those puzzling questions like, "What's the gain of this stage; input vs output?" It'll show you. There are many similar uses.

The Leader LBO-302 is a late entry into this field. It's a dual-trace scope, with excellent bandwidth; dc to 8 MHz on both channels. Calibrated attenuators are used, giving sensitivity from 0.01 volt/div to 5.0 volts/div. With the 10:1 low-capacitance probes supplied, this will allow readings up to 50 volts/div. The attenuators can be switched from ac to dc to ground (for calibrating). Separate positioning controls for each channel can be used to set either trace where you want it. The two channels have identical controls, attenuators, etc.

The LBO-302 doesn't use dual-gun CRT. The two channel displays are alternately switched, at low frequencies, and "chopped" at higher frequencies. The transition is automatic, and you can't detect the switch. Both displays show continuous traces. The channel 2 signal can be inverted in polarity, by a pushbutton switch, to make comparisons simpler. Triggering can be switched to either channel.

The LBO-302 has triggered sweep. The trigger action is extremely good; patterns are rock-steady in either Auto or variable-level position. Incidentally; when using a triggered-sweep scope; at times you'll wonder whether you do have a signal or not. This has been taken care of! Just push the little button marked FREE RUN, and the pattern will appear.

You get positive locking of the pattern on an input signal as small as 1 division on the graticule. The actual voltage needed, of course, depends on the setting of the vertical attenuator. Trigger position can be set for either the positive or negative-going slope of the waveform. An external triggering signal may be used, if needed. To make a closer examination of certain parts of a waveform, a 5X magnification is available, by pulling out on the HORIZONTAL POSITIONING knob. Handy for looking at the color-burst, or whatever you want.

A pair of very well-made LC probes come with the LBO-302. These are small and light, and have spring-loaded, insulated hook-tips, which makes it easy to connect them to any point desired. This tip can be unscrewed, and a fixed hook or straight tip put on. One of the things I like about these is the length; they made the cables long enough! These are about 3 feet long, which makes them a lot easier to work with.

The LBO-302 has provisions for use as a vectorscope, with any colorbar generator (I imagine they'd recommend the LCG-391, which is made by the same company)! Changeover switches are provided on the back panel of the cabinet. These are locked by a screw, so that you can't knock them into the wrong position accidentally. Input jacks for the connections to the R-Y and B-Y circuits are also on the back panel. If you need an intensity-modulation input, this jack is also back there. (Z-Axis input.)

The horizontal sweep (or, I should say TIME/DIV switch since this is a triggered-sweep type) goes from a very slow 2 seconds/div to a very fast 1.0 μs/div. For fast TV checking, special preset TV-V(ertical) and TV-H(orizontal) positions are also provided.

For sweep alignment work, an EXTERNAL HORIZONTAL input is provided on the front panel. In the rest of the switch positions, this serves as the EXTERNAL TRIGGER input; internal and external trigger can be selected with a slide switch.

The two probes plug into a special panel on the top of the case, at the right front. The LBO-302 is a very compact instrument; takes up very little room on the bench.

While playing with it (I know; this should be work, but I like it so well that it's play)! I found a way of reading p-p voltages. Set the TRIGGER switch back far enough so that it won't scan; turn up the intensity control a bit, then move the spot to the right with the horizontal positioning control. You'll see only a thin vertical line on the screen. The height of this line is directly proportional to the p-p voltage of the waveform. This sometimes makes it a little bit easier to read.

A very complete instruction manual comes with the LBO-302. This not only gives you full details on how to make all of the many tests that this versatile little feller will do, but also complete data on recalibrating, testing and maintenance. **R-E**

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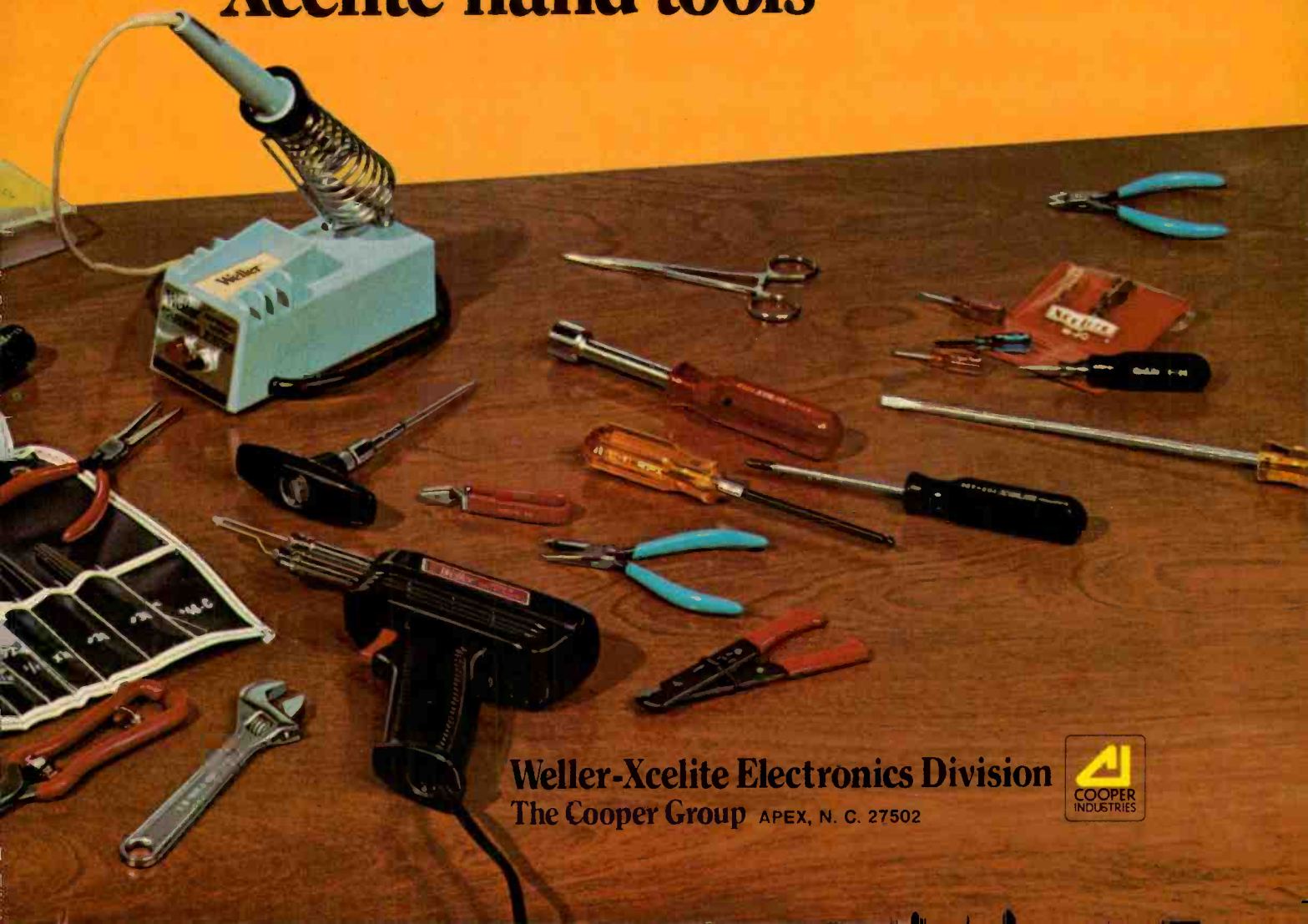

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COOPER INDUSTRIES

new & timely

(continued from page 12)

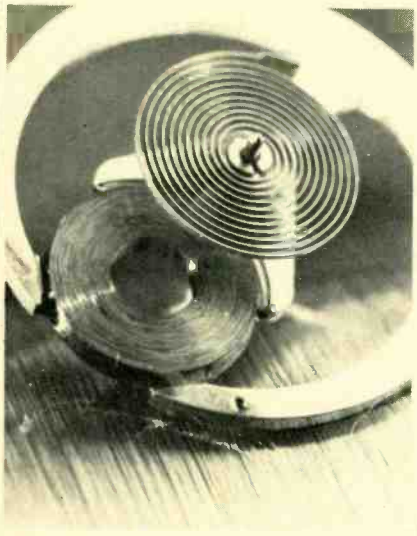
Not large from a layman's point of view, the nickel-size device was called a "key achievement" by Dr. Karl H. Zaininger of the RCA Laboratories, where it was developed. "Manufacturable CCD sensors of at least this size are essential if all-solid-state TV cameras are to have the resolution to satisfy a broad range of applications," he said, going on to state that TV cameras with CCD's could be made the size of a cigarette package, or smaller. Such cameras would be especially useful in space exploration, military programs, surveillance systems and a number of other applications requiring small dimensions or low weight.

"Invisible" wire now obtainable

Ultrafine wire, in diameters of 10 to 28 microns (equivalent to AWG Nos. 57 to 49) is now being offered by Raytheon. The wire is made in Germany by Lacroix and Dress, a firm acquired by Raytheon last year.

The high-purity, low-oxygen wire is used in electronic watches, cameras, ultra-miniature electric motors, hearing aids, and other devices requiring extreme miniaturization and low current drain. The manufacturer states that its exceptional smoothness and purity enable the near-invisible wire to be wound without costly breaks.

The new wire is supplied with solderable or non-solderable enamel coatings, and can also be supplied with a self-bonding coat that will form a self-supporting coil when mild heat is applied.



ONE-TENTH AS THICK AS HUMAN HAIR, this coil of wire, shown with the hairspring and balance wheel of a watch, is being used in an electronic watch. Wire is .0007-inch thick.

TELEPRINTER, NEW AID TO THE DEAF, enables Mrs. Lyn Gerlis of Nanuet, N.Y., deaf since birth, to "talk" to her mother, Mrs. Elsie Sokal, who lives on Long Island. The two teleprinters were donated by ITT World Communications. Conversation is transmitted over the ordinary phone line with the help of the acoustical coupler seen beside the phone. Mrs. Gerlis' husband, Stewart, and 16-month-old son, Sean, watch the conversation. More than 100 printers have been distributed in the New York metropolitan area through the New York-New Jersey Teletypewriters for the Deaf, Inc.

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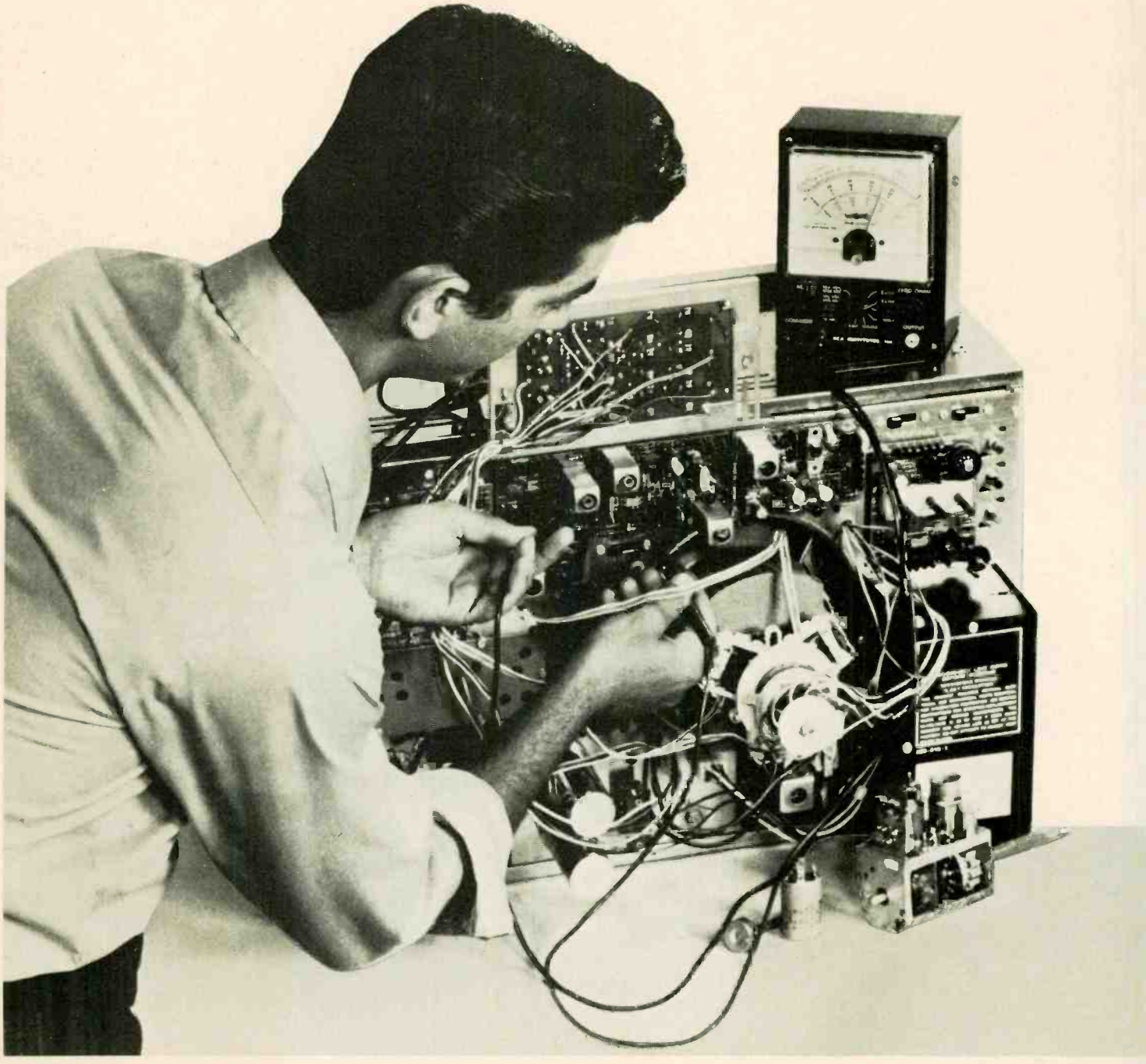

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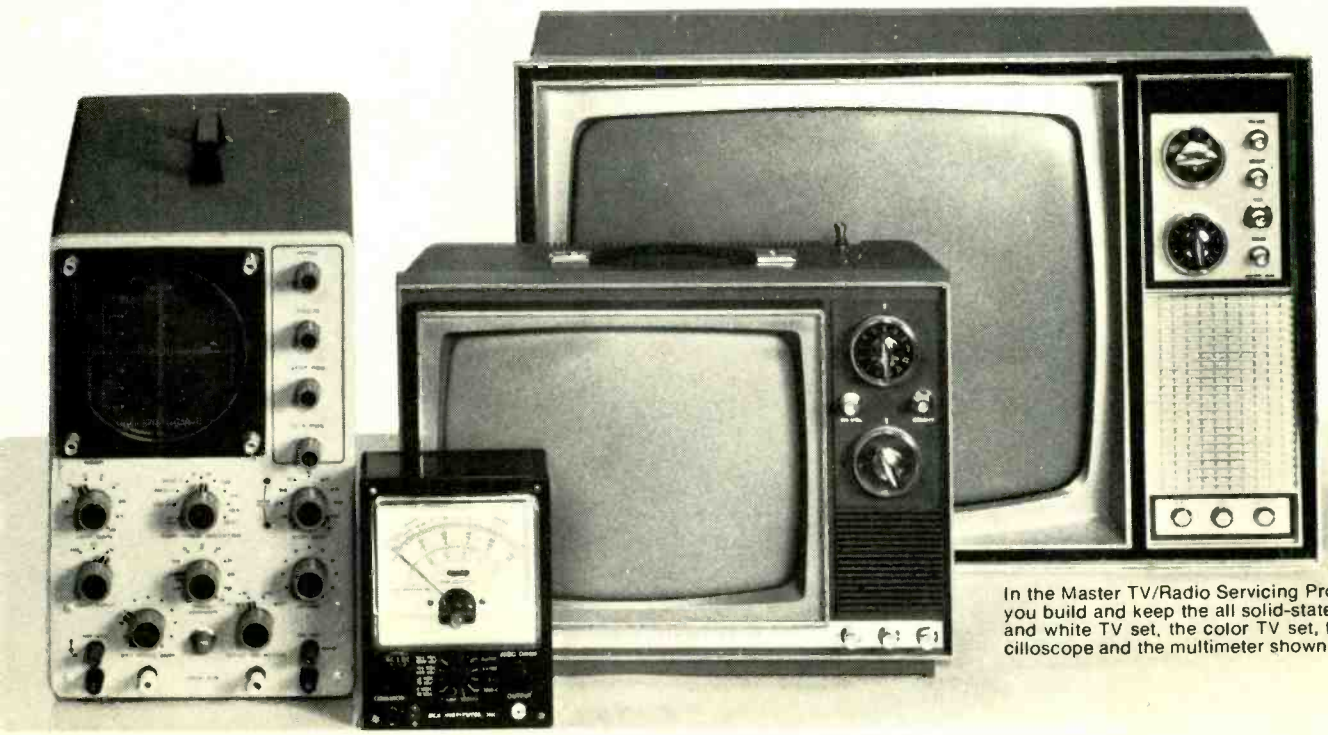
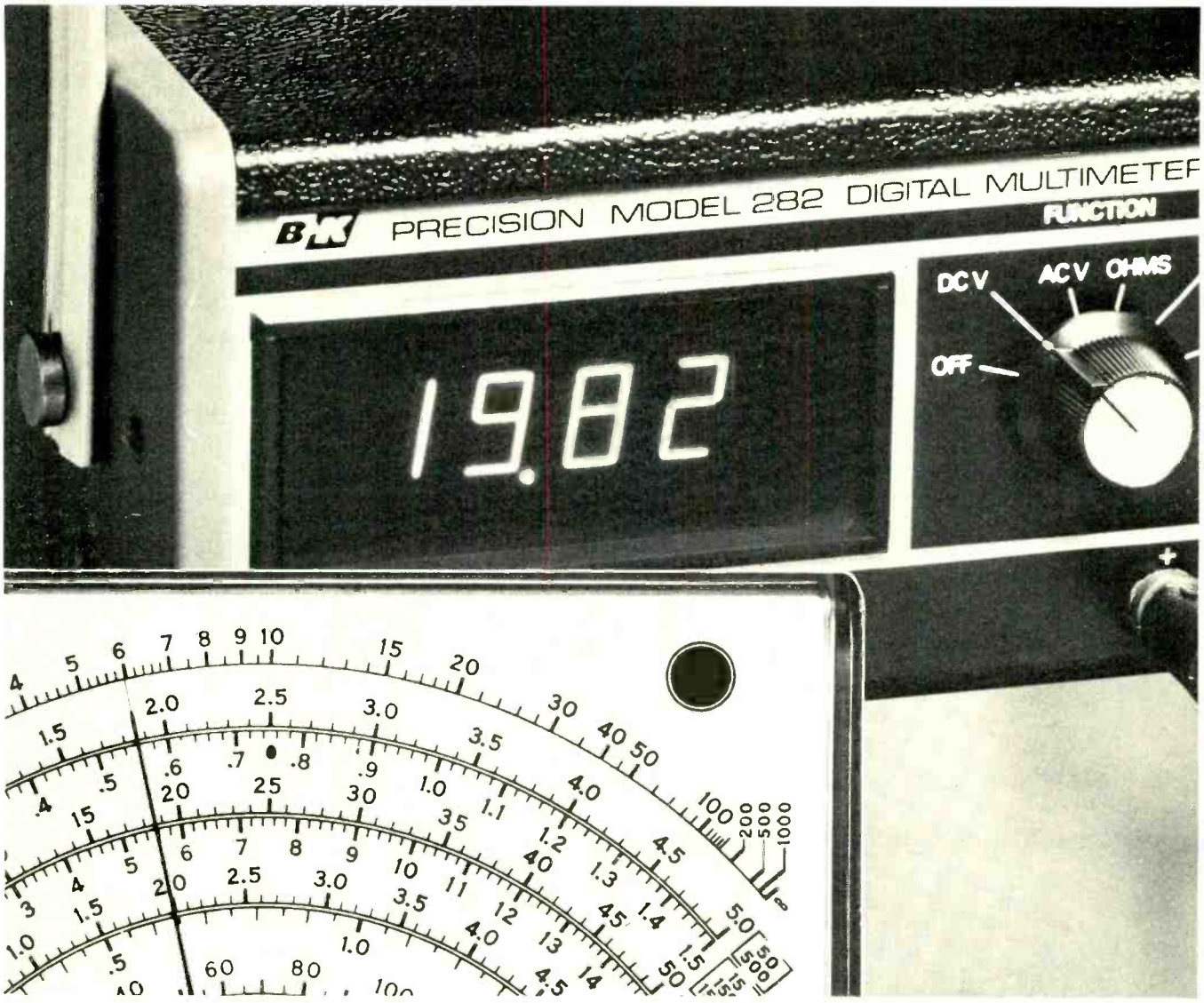


In the Master TV/Radio Servicing Program, you build and keep the all solid-state black and white TV set, the color TV set, the oscilloscope and the multimeter shown above.



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Even at readings close to 50 volts, where the analog multimeter is most accurate, Model 282 *remains more than six times as accurate as the analog multimeter.*

As for ease of reading . . . the picture above shows Model 282 and the analog meter full size. Put it where you'd normally set up your multimeter and see for yourself how much more easily you can read the 282's bright digital display.

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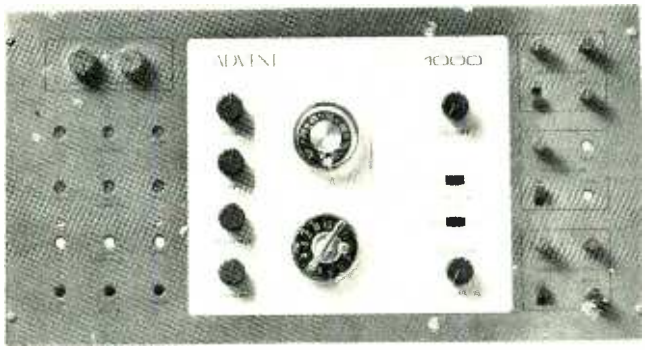
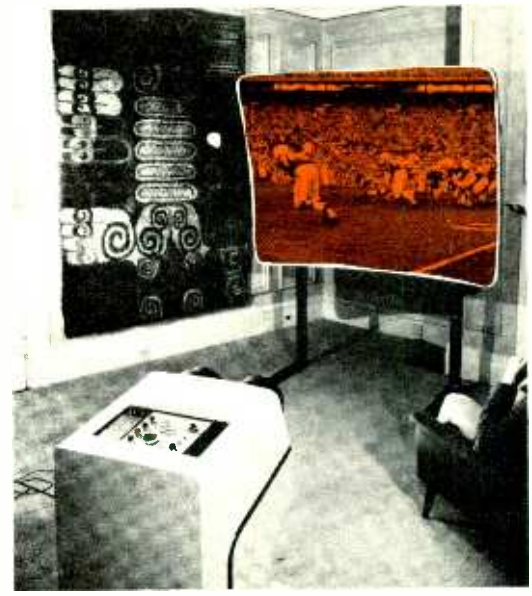


THESE ARE THE CONTROLS you use to operate a VideoBeam projection color set.



Life-size TV pictures on a 4 x 5-foot screen in your own livingroom is not a dream. It costs $2495, but it is here now.

by LARRY STECKLER, EDITOR

FOUR BY FIVE-FOOT COLOR TV PICtures in your own livingroom—today! No, it's not science fiction, nor does it have to wait for some still-to-come development to make it possible. It is the Advent Corporation's latest product—VideoBeam Projection Color Television. And you can buy it now

Picture size is more than ten times that of the largest (25-inch diagonal) conventional color TV set. Its usable viewing area is more than 24 square feet (about 4¼ feet tall and 5 2/3 feet wide). That's almost life size. The big picture is clear, well defined, and bright enough to watch in a room with moderate background lighting. It costs $2495.

Unlike other TV's, the VideoBeam set comes in two major pieces—a receiver-projector and a separate rather-special screen. The receiver-projector plucks the TV signals out of the air, just like any other color TV, but as the signal is received, the projector beams the resulting picture across the room to the separate screen. All of the electronic steps needed to produce a television picture are taken inside the projector-receiver, and what travels from the projector to the screen is a beam of projected light, just like that from a motion-picture camera. The electron beam that produces the picture is not projected, and the set operates at voltage levels very close to those of conventional color sets so there is no additional radiation hazard.

The screen

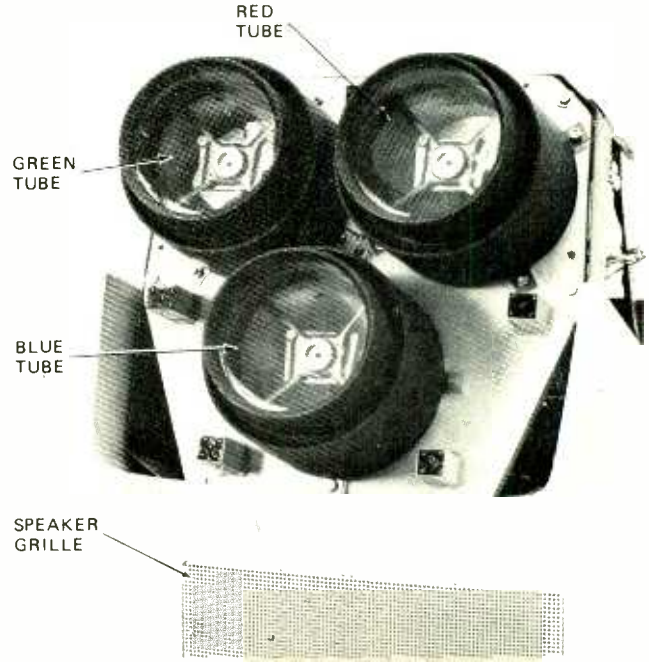
Obviously, the screen has no resemblance to a conventional TV screen. It has no phosphor coating, and no electronic circuitry. Essentially, it is an advanced kind of movie screen. Its surface is curved, and it is coated with a new, highly-reflective aluminum screen material. It stands on legs, with its lower edge 32 inches off the floor, and its total height is about 7 feet. Wall mounting is possible (brackets are available) but requires extra care and effort.

There is no wiring between the projector and the screen. Sound as well as the picture is beamed at the screen from the projector, and is effectively bounced back at the viewers.

The VideoBeam receiver-projector

The projector unit is in a molded plastic console. All the usual controls are on the top of the 33-inch high unit. Three separate projection tubes at the front of the cabinet transmit the three primary colors. One tube is red, one is blue and the third is green—the same three colors used in conventional color TV tubes. The three beams are converged at the screen to produce a full-color picture.

The screen must be placed about 8 feet in front of the projector. This is a fixed distance and cannot be varied more than 1½ inches in either direc-



THREE PROJECTION TUBES put the TV picture on the screen. Here, with part of the console case removed you can see how the projection tubes are positioned

tion. Picture size is also fixed along with the angle of projection and the height of the projector and screen.

The projector has the same basic picture controls as any color TV set and, therefore, is operated in the same way. There are some additional controls to make it simple to maintain optimum focus and convergence, and to reestablish best picture quality if the projector is moved.

The sound is produced by a single wide-range acoustic suspension speaker that is driven by a 5-watt low-distortion amplifier that delivers suprisingly good sound.

With the sole exception of the projection tubes all electronics are solid-state. Modular plug-in boards make rapid easy service possible should it become necessary. A comprehensive service manual that will permit any TV service technician to repair this set is available from Advent, and qualified factory personnel will accept telephone questions from technians should a problem arise. The manual is a loose-leaf book that shows each circuit in the receiver along with a detailed description of circuit operation. Where IC's are used, even the circuit inside the IC is shown.

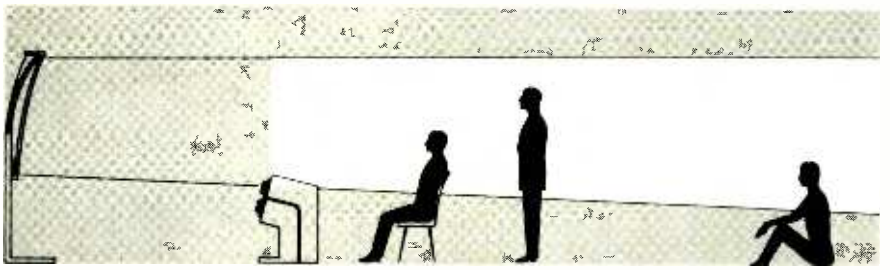
Look at that picture

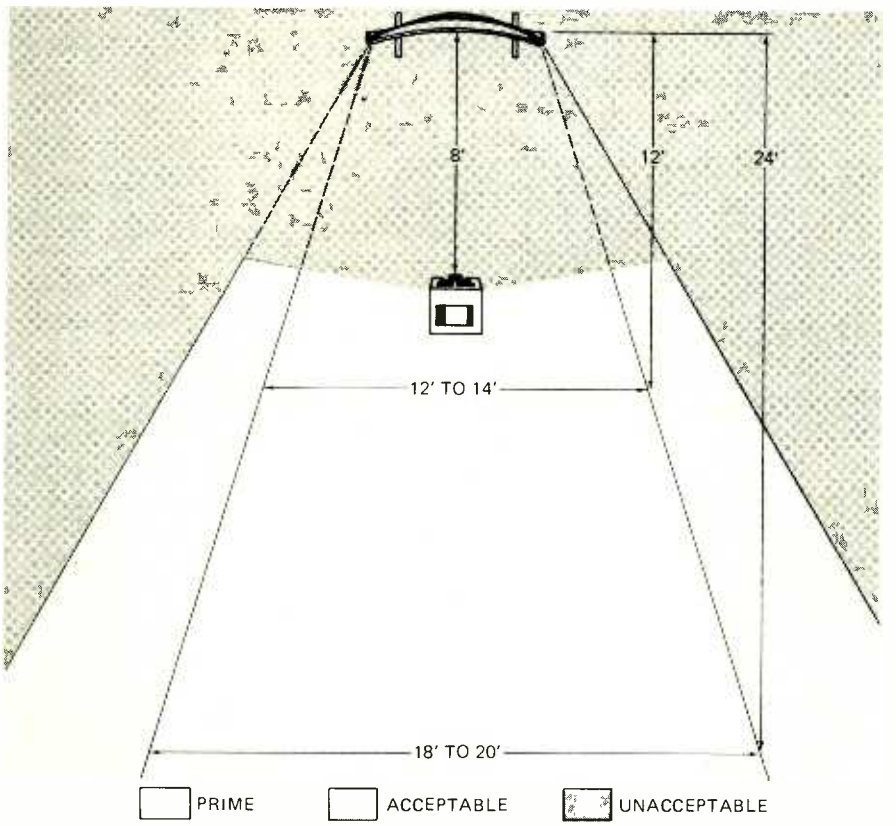
The curved highly-reflective screen is an important part of the picture system. If you took the screen away and projected the picture on a flat white wall, it would be barely visible. The screen spreads light effectively over a gradually widening area and focusses it vertically over the range where the viewers are likely to be seated or standing. At a distance of 12 feet back from the screen, the ideal viewing area is 12 to 14 feet wide and the acceptable area is 18 to 20 feet. Outside these boundaries, which continue to widen as you get further away from the screen, brightness and apparent color intensity lessen, but there are no distorted optical effects.

One key factor in the picture clarity is that the set maintains proper vertical interlace of the scanning lines that make up the TV picture. Interlace is improving in most modern sets but in some instances is still so badly maintained that the lines essentially drift together, cutting picture resolution in half, and causing the scanning lines to become visible on the screen. (Things have been this way for so long that some people believe that the scanning lines are supposed to be visible which just isn't true.)

The VideoBeam set also provides full dc restoration of the black level in a picture avoiding the loss of detail that can occur in the dark areas of a picture. This loss is particularly obvious when there is a sudden camera switch from a very light to a very dark subject. Full restoration provides this deteil, keeps large dark picture areas blacker and improves contrast.

Since final picture quality depends to a great extent on reception conditions and the quality of the signal appearing at the antenna terminals of the set, a good antenna system is a must. With the large screen, even minor signal deficiencies become obvious, while they might not bother you on a smaller conventional set.





WHERE YOU SIT TO WATCH TV IS IMPORTANT These two drawings show the proper viewing positions. All other positions are not acceptable.

Where do you put it?

The Videobeam set is far from a personal portable, but it should fit into the average home. The basic requirements are an unobstructed 8-foot projection span and a comfortable viewing area alongside and behind the projector.

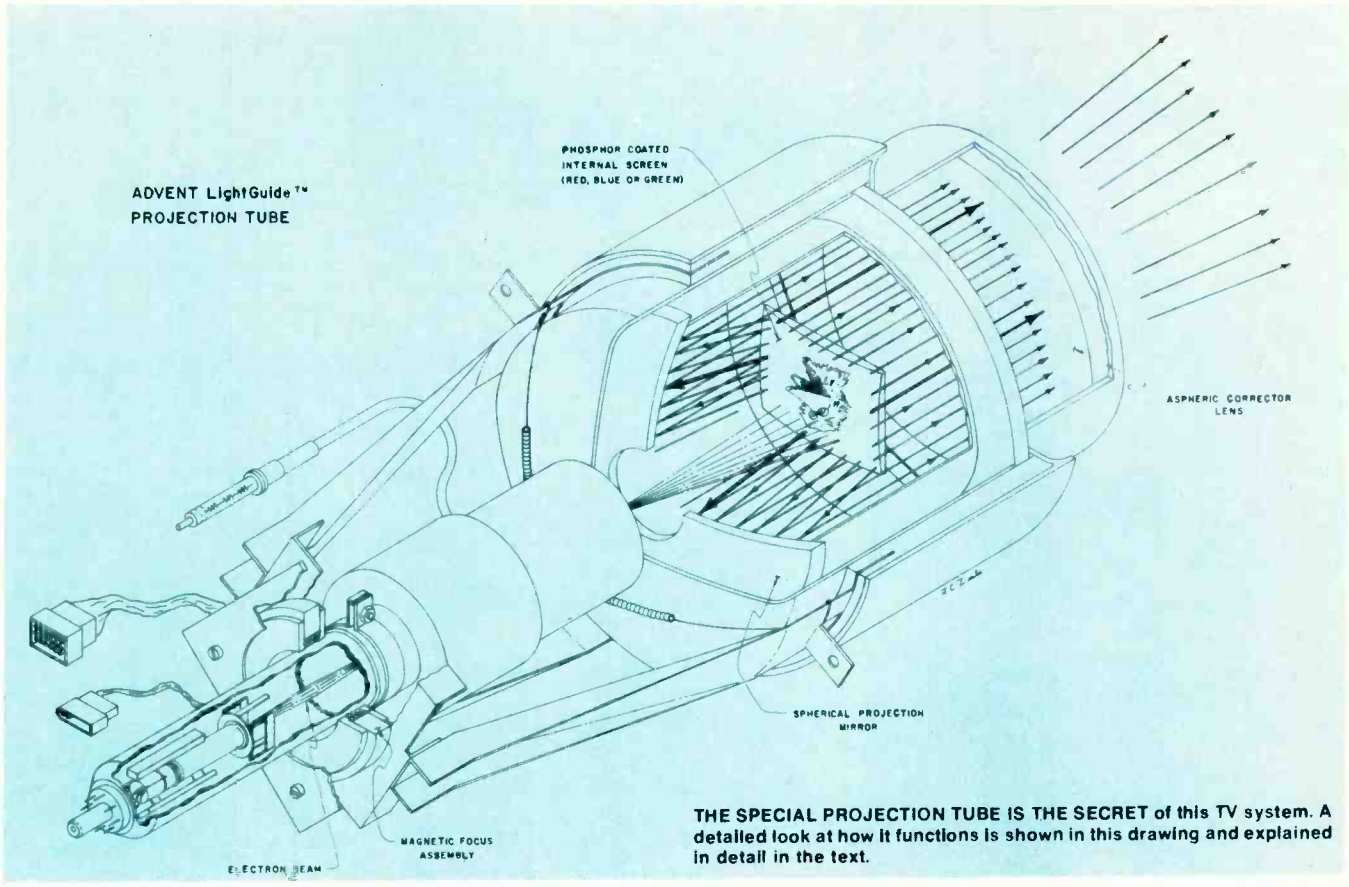
For most of us, videocassettes or video disc playback is still some time in the future. But when prerecorded video programs do become available, the VideoBeam projector will be ideal for playback. In fact the set is designed with video recording and playback in mind. Inputs to the set are provided both by way of the antenna terminals and by a special direct input that bypasses the rf stage of the set. These two inputs will accomodate future as well as present playback devices.

A video output jack makes it easy to record TV programs with an external video recorder. A separate audio output jack permits playing the audio channel through a hi-fi system or provides for taping by an audio tape recorder.

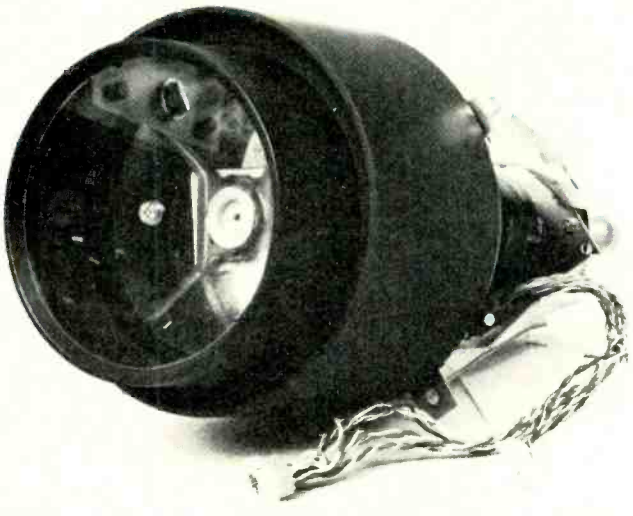
How it's done

As we all know, color television broadcasts are a mixture of three color signals—one red, one blue and one green. When these signals are properly recombined in a receiver, the full range of visible color is produced.

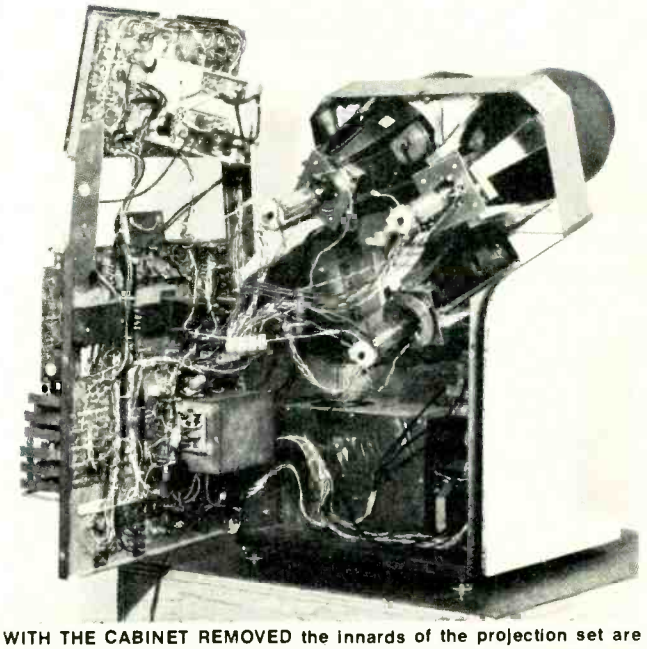
In the Advent VideoBeam projec-



THE SPECIAL PROJECTION TUBE IS THE SECRET of this TV system. A detailed look at how it functions is shown in this drawing and explained in detail in the text.



PHOTOGRAPH OF ONE OF THE THREE PROJECTION TUBES. The single lens in front of the tube is the only external optical element and plays an important part in making the system possible.



WITH THE CABINET REMOVED the innards of the projection set are revealed. Note the easy access to parts which speeds and eases servicing should it be required.

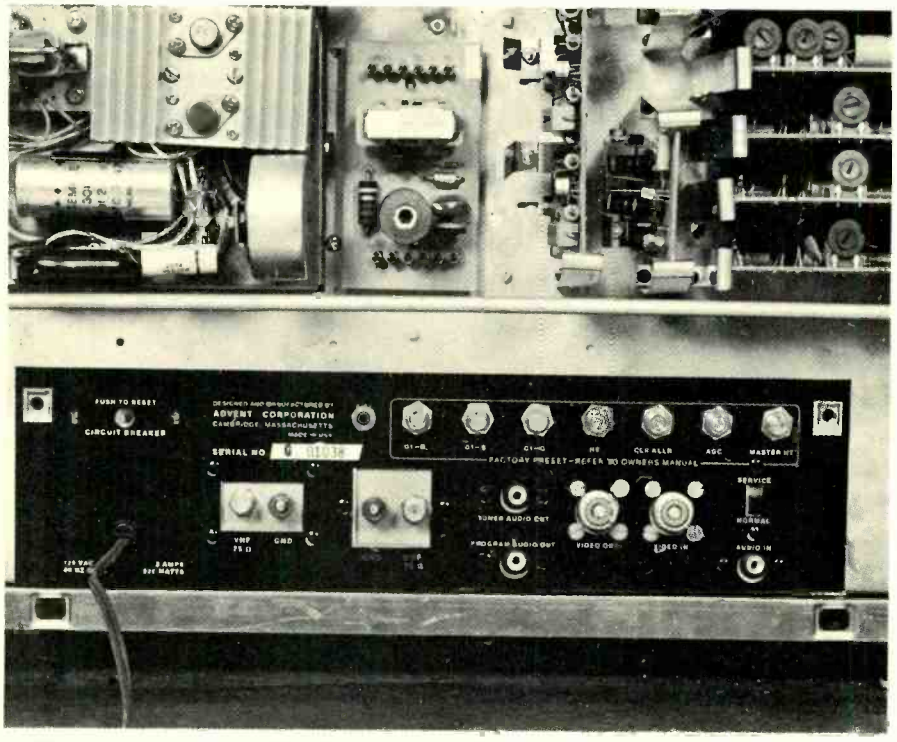
tion design, there are three separate LightGuide projection tubes, one for each color. Inside each tube is a single electron gun for the color that tube will project to the screen across the room. The gun is aimed to sweep back and forth over a three-inch phosphor-coated target screen inside the tube, which lights up the color of the phosphor coating. Since the light emitting coating only has to produce one color, it can be uniformly covered with a single phosphor for that color. The color dots or lattices of conventional sets are not needed, nor is a shadow mask—making tube efficiency much greater than is possible in a direct-view picture. This efficiency is the key to a bright projection picture.

The diagram shows how the picture from the light-emitting target is projected. The light given off is reflected by a spherical mirror, that directs the light out of the tube via a corrective lens. The mirror focusses the light from each point of the internal target to the corresponding area of the big screen across the room. When the separate blue, red, and green images from the three projection tubes converge on the screen, the full-color picture is produced.

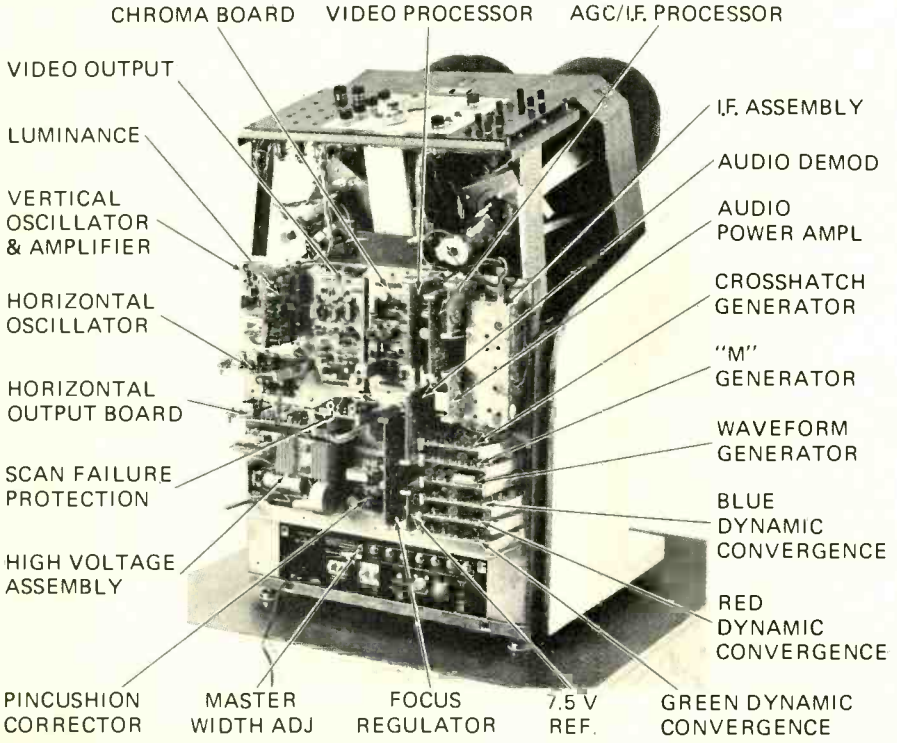
As roundabout as this may seem, it is

much simpler than the usual color television technique. The beam from the single electron gun inside each tube sweeps back and forth over a span of only 15° instead of the 90° span in the ordinary color tube. This makes it far easier to maintain picture linearity across the screen. Also, there is no need for clusters of color dots or for the color lattices used in newer picture tubes, and no concern that an electron beam might strike the wrong color phosphor. The result is that the usual fussy convergence of three colors on the face of a picture tube becomes the simpler matter of overlapping the beams from the three projection tubes on the large external screen.

The projection tube also contains all the critical optical elements, sealed in a fixed relationship inside the tube. This allows all critical optical adjustments to be made only once—during manufacture of the tube. This also keeps these optical elements dust free. The only optical element exposed is the front of the corrector lens which does require occasional dusting.



SERVICE CONTROLS ARE LOCATED AT THE BOTTOM of the rear chassis. Some of the plug-in circuit modules can be seen above this panel.



LOOKING FROM THE REAR major sections of the projection chassis are identified. Once again the plastic case has been removed to provide access.

What's it like?

I've only spent a few hours watching the VideoBeam projection TV and have not yet experienced it for an extended time in my home environment, but I do have some immediate comments.

The huge picture is a great advantage when watching certain types of TV programming. A Jack Cousteau feature on life in the sea or a football or a baseball game are simply tremendous. The near life-size pictures put you right in the middle of the action.

But even regular programming beomes more exciting. You can see not just more close-up detail, but more of what is happening too. Instead of being locked into looking straight ahead, your eyes are free to move, to follow the action. The added realism cannot be described.

The bad, of course, becomes just as exaggerated as the good, and there is plenty of it. Technical flaws, in particular, from out-of-focus camera work to commercials shot in a hurry on mediocre equipment, show up unmistakeably at life size. Poor-quality broadcasting, especially when the colors aren't right, is much more visible and annoying on the big screen. And the variation in quality from station to station, program to program, or even moment to moment on a particular program is striking.

Overall, the big picture is a great way to watch color TV. At $2495 it remains beyond the reach of most of us, but the picture size and quality make you wish you had one in your home today. **R-E**

"This book has increased our business 25%! Our phone number is inside the back cover."

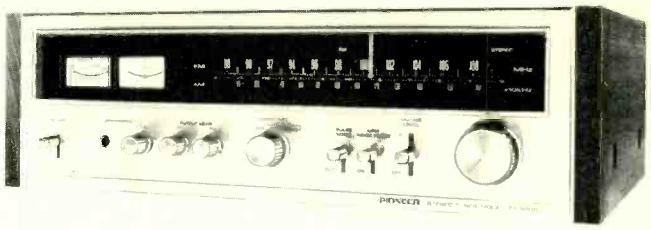


FIG. 1—PIONEER MODEL TX-9100 STEREO tuner is a typical example of a high-quality FM tuner.

New FM Tuner Circuits

Much of the improved performance in recent high-fidelity FM tuners and receivers involves innovations in signal handling and processing. Here's how Pioneer treats impulse and interstation noise problems.

by LEN FELDMAN
CONTRIBUTING HIGH-FIDELITY EDITOR

SOME TIME AGO, WE HAD AN OPportunity to test a high-quality tuner, Pioneer TX-9100. Shown in the photo of Fig. 1. In addition to its excellent performance in terms of FM reception, the tuner includes a unique noise-suppression circuit that significantly reduces the audible effects of local ignition noise and other electrical interferences. Of course, we all know that FM is supposed to be immune to amplitude-varying noise signals. To a large extent, it is; but in the real world, just run an electrical razor or a sparking electric drill motor near your FM tuner or receiver and you'll quickly realize that theory is one thing, and practice is another.

Exploring other FM products, we found that one or two Sony FM components introduced a year or so ago also feature an effective ignition noise or pulse noise reducing circuit. The unique aspect of the Pioneer circuit is the fact that it not only reduces this form of interference without affecting frequency response of audio programming but it also provides an elegant "clue" for an effective interstation muting circuit which can now be made to function on the basis of signal-to-noise content rather than purely on the basis of actual signal strength which most muting circuits rely upon.

Figure 2 is a block diagram of the entire pulse noise suppression and muting circuit of the TX-9100. The pulse noise suppressor consists of a noise-level sensor, a high-pass filter plus pulse generator, a signal time-delay circuit and a gating circuit.

Noise level sensor

After FM detection, the total composite signal is amplified by an audio amplifying stage. The output of this stage is fed first to a high-pass filter having a cut-off frequency of 150 kHz and then to the noise-level sensing circuit, a partial schematic of which is shown in Fig. 3. Noise pulses having rapid rise times are amplified by Q14 and Q15. Output from these stages is rectified by D11 and D10 producing a negative output, which is fed to the base of Q16.

The internal impedance of Q16 varies based upon the negative voltage supplied and, therefore, the emitter voltage of Q16 is controlled by the amplitude and repetition rate of the incoming noise pulses. The resulting dc output is used as an agc control voltage for Q14 as well, and its gain is, therefore, maximum when no noise appears with the composite signal. As we shall see presently, the same dc output is used to control the muting circuit as well.

Pulse generator

The output of the high-pass filter is also fed to a pulse generator circuit. This circuit is designed to produce negative pulses based upon the amplitude and quality of the incoming pulse noise, which is amplified by Q19 in Fig. 4 and then half-wave rectified by D12 to produce the positive halves of the noise pulses. These positive pulses are amplified by Q20 and are used to trigger a Schmitt trigger (Q21 and Q22). The Schmitt trigger is so arranged that

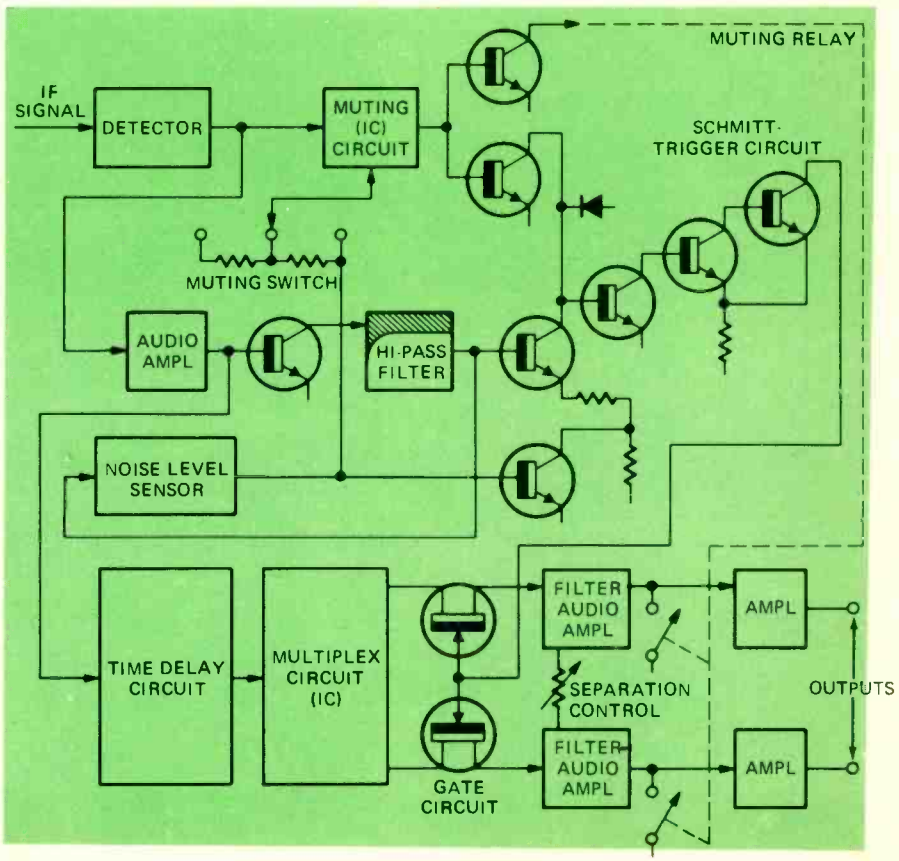


FIG. 2—BLOCK DIAGRAM OF NOISE-PULSE SUPPRESSION and muting circuits in Pioneer TX-9100 tuner.

low-level noises will not activate it. Note that the circuit also has a shut-off feature for the pulse generator. This is done for the following reason.

Suppose for example, that the muting switch on the front panel is in the off position because a listener wishes to hear a weak station, however noisy it might be. Because of the high noise level, the pulse generator might then feed a continuous negative voltage to the gate circuit and might shut off the audio circuit entirely much like a regular muting circuit. Under such circumstances, the base of Q20 is grounded by an external connection (not shown in Fig. 4) thereby preventing the Schmitt trigger from generating pulses.

Gating circuit

The gating circuit consists of two FET's, two diodes and two "holding capacitors" as shown in Fig. 5. Negative pulses from the pulse generator circuit are fed to the gates of the FET's causing source and drain to "open circuit" instantaneously and thereby shutting off the audio signals. (When negative voltage is applied to the gate of a FET, its internal impedance becomes infinite.

At first glance, it would seem that the audio signal goes to "zero" instantaneously but in fact, holding capacitors C16 and C17 hold the level until the gate is closed again. Thus, the audio waveform contains only a small notch for each negative pulse. Since the width of the negative pulse is only about 18 μs or so, the notch produces very little audible effect—far less than would have been heard if the noise spike itself were riding through with the signal.

Delay circuit

To synchronize the timing of the gating circuit and the incoming noise, the entire composite signal is delayed by a few microseconds before application to the multiplex audio circuits.

The muting circuits

The muting circuit of this tuner is unique since muting is activated by the signal-to-noise ratio and the dc voltage from the detector output, rather than by arbitrary levels of input signal strength. As mentioned earlier, the noise level sensor circuit shown in the partial schematic of Fig. 3 is involved in the muting circuit too. The negative output produced by the noise-level sonsor is fed to the muting IC. As this negative voltage becomes greater, the relay is activated, muting the audio signal.

Another input to the muting IC is direct coupled dc output from the FM ratio detector. The familiar S-cruve of such a detector is shown in Figs. 6-a and 6-b. In a properly aligned ratio detector greatest linearity of detection occurs when the dc voltage at the output of the ratio detector is zero. When the tuner is detuned, detector output may be either positive or negative.

In Fig. 6-a, a positively detuned condition results in the recovery of the distorted audio waveform, especially at

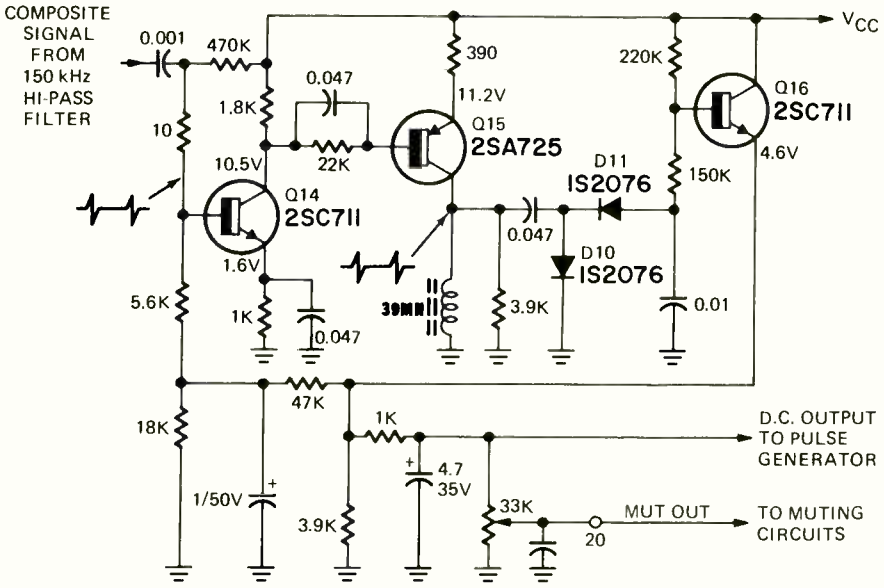


FIG. 3—PARTIAL SCHEMATIC OF NOISE-LEVELsensing circuit.

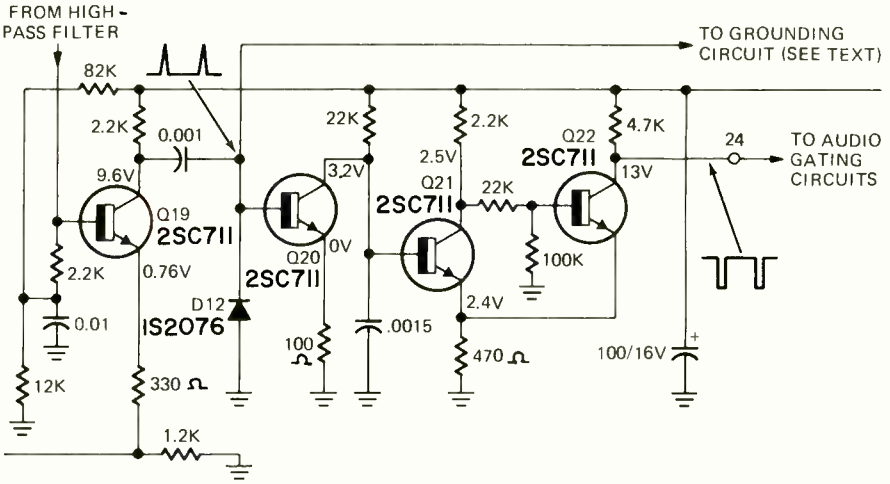


FIG. 4—PULSE-GENERATOR CIRCUIT uses Schmitt trigger to generate negative controlled pulses based on signal noise content.

stereo headphone amplifiers. Thus, even when using phones only, full advantage of the muting and noise pulse suppression features can be had.

In view of the accurate sensing method of low distortion tuning made possible by this dual input muting circuit, readers might wonder why the tuner needed a center-of-channel tuning meter. The answer is twofold. First, as with all high-quality tuners, the muting circuit can be defeated with a front-panel switch. This is done so that listeners desiring to hear weak or distant signals can do so, if they are willing to tolerate the accompanying noise. In the case of the Pioneer TX-9100, it was found that signal inputs below approximately 6-μV will be blocked by the muting circuit. As has been pointed out, however, unlike more conventional muting circuits the threshold will vary somewhat from location to location, depending upon local noise conditions.

Secondly, since the "window" of the center tune feature in the muting circuit has finite width (muting will be overcome even when the dc output of the or near the 100% (± 75 kHz) modulation level. The input to the muting IC to which the dc level of the detector is applied is so arranged that a departure from close to 0 volts dc at that point will also activate the muting relay for muting of the audio signal. As proper centered tuning of the desired station is approached, dc output from the detector approaches 0 volts, the relay is deactivated and linear low distortion audio signals are fed through the outputs, as illustrated in Fig. 6-b.

The actual relay used for muting is a sealed reed type, noted for total absence of low-frequency "popping" noises, when it is activated or deactivated. The relay is positioned just ahead of the emitter follower output stages of the tuner, which feed the variable and fixed level output jacks of the tuner, as well as the self-contained

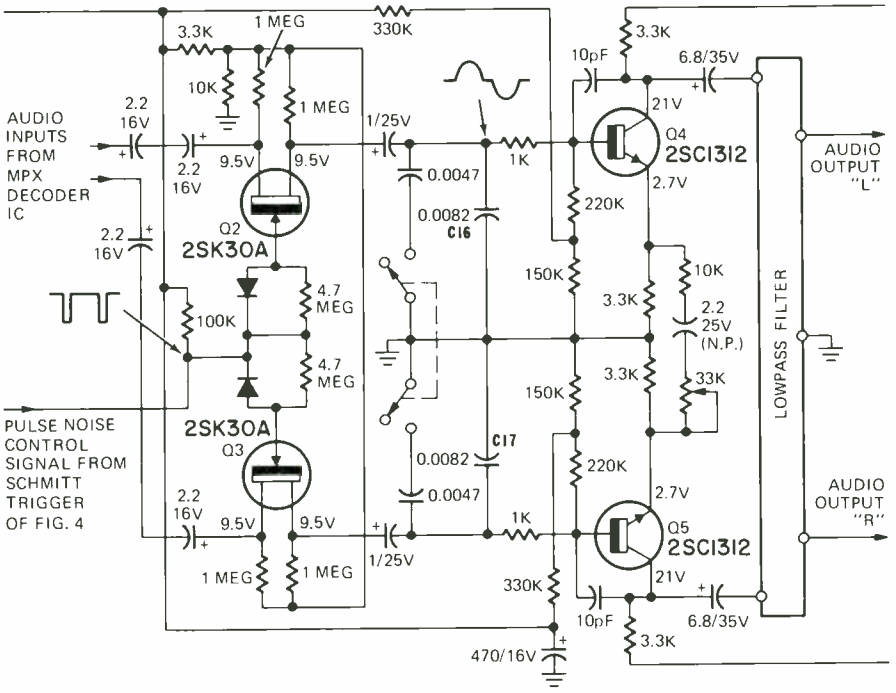


FIG. 5—FET'S IN GATING CIRCUIT block passage of audio signals when their impedance becomes "infinite" by application of negative pulses to their gate elements.

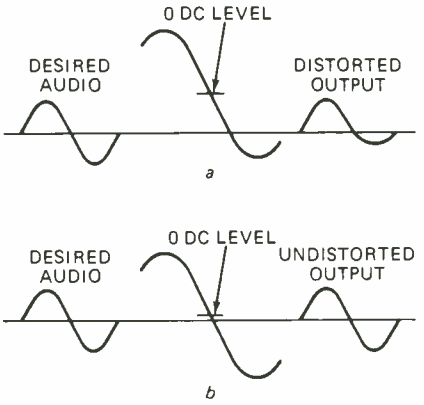


FIG. 6—DETUNING AN FM TUNER causes detection to occur over non-linear portion of ratio-detector's "S" curve (a). When set is properly tuned (b), recovered audio has least harmonic distortion.

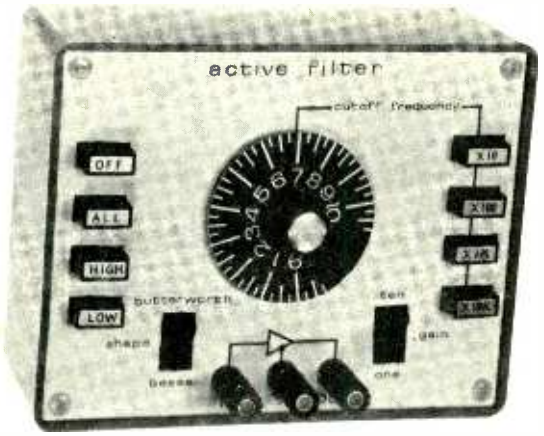
detector is slightly off "absolute zero") the presence of the center tune meter enables the user to further zero in on the most linear portion of the ratio detector S curve.

Interestingly, however, with average signal input levels (100 μV or higher) measurements showed that even with the dial tuned to the edge of the muting "window" (either on the "plus" side or the "minus" side) total harmonic distortion measured no greater than 0.25%—a highly acceptable figure.

Under the same input signal conditions, trimming the dial setting by means of the center of channel tuning indicator further reduced the THD reading to between 0.12% and 0.15%.

All of these measurements were made under "worst condition" 100% modulation. Since most FM broadcasts stay well below full deviation an average program material, typical THD figures under musical or voice listening conditions might be expected to be even lower than these incredibly low test condition figures.

With so much emphasis these days on amplifier refinements and four-channel circuitry, it's good to see that some companies have not forgotten the most popular high fidelity program source of all—FM broadcasting. As new FM circuit refinements appear in future products we will try to bring them to you. **R-E**



ACTIVE BANDPASS FILTERS

SOMETIMES A NEW VERSION OF A CIRcuit comes along that seems complicated at first, but ends up solving a lot of problems in a simple way. This is certainly true of an active bandpass filter technique called *biquadratic section*. It seems to take a lot of parts —including three operational amplifiers. But you end up with stable and simple operation, high Q, easy design, and independent control of practically everything. You'll find the circuit handy for bandpass filters of all types, particularly in electronic music and percussion circuits.

A *bandpass* filter is one that favors one frequency or a narrow group of frequencies. A series R-L-C circuit such as Fig. 1 is called a *single pole* bandpass filter. It passes one frequency with theoretically zero loss, and provides progressively higher losses above or below that selected frequency.

There are two things you can control. One is the *center frequency* or *resonant frequency*. This is determined by the size of the inductance and capacitance, using the familiar formula

$$f_{res} = \frac{1}{2\pi\sqrt{LC}}$$

The curves in Fig. 1 are shown *normalized* to some center frequency F_0. Double the L-C product, and the frequency gets cut in *half*, and so on.

The other thing we can control is the *bandwidth*. This is also known as 1/Q and is the width of the response between the upper and lower −3-decibel- (0.707 amplitude) points. The Q is controlled by setting the *ratio* of *inductance* to *capacitance*. Another form for Q is

$$Q = \frac{2\pi Lf}{R}$$

Bandwidth is normally referred to the center frequency with these two expressions:

Bandwith =

$$\frac{\text{Upper } F_{3DB} - \text{Lower } F_{3DB}}{\text{Center Frequency}}$$

and

$$\text{Center Frequency} = \sqrt{(\text{Upper } F_{3DB})(\text{Lower } F_{3DB})}$$

Bandwidth and Q not only determine the width between the 3-dB points, but they also determine how steeply the curve initially falls off either side of the passband. Note that all the curves end up *eventually* falling off in either direction at a rate of 6 dB per octave (half amplitude as you double or halve the frequency of the stopbands). This ultimate levelling off is caused by the reactance of either the inductor or the capacitor becoming negligible at frequencies well above or well below resonance.

If we want more steepness than we can get with a single R-L-C section, we can cascade several identical sections, perhaps staggering them in frequency to get an overall response shape that is flat or slightly dipped instead of peaked.

There are several problems with the passive circuit. The inductor is usually big, expensive, and not adjustable over a wide range. Secondly, the circuit is load sensitive. Finally, there's a bunch of minor problems such as hum getting into the inductor field, and the difficulty of cascading sections without interaction. To get around these problems, circuit designers have come up with a number of *active filter* circuits that use resistors, capacitors, and operational amplifiers to *simulate* the performance of L-C circuits. One particular circuit of this type is called the *biquadratic bandpass section*. It is shown in Fig. 2.

Unlike many simpler bandpass active circuits, this one lets you *independently* control the circuit gain, the center frequency, and the bandwidth or Q. Gain and Q are changed by changing a single resistor. You can use either one or two resistor adjustments to change the center frequency, and do so independent of Q. The table shows the component values for various Q's and center frequencies.

To trim the center frequency, you vary R2. To change Q, you change R1, and to change gain, you vary R3. The

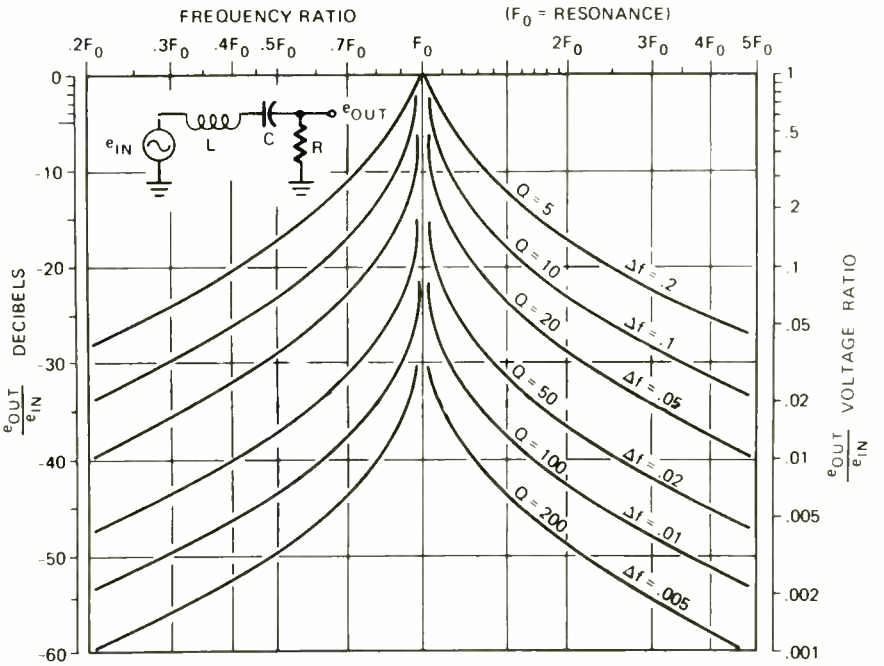


FIG. 1—SINGLE-POLE R-L-C filter and its universal response curves. The bandwidth is determined by the Q of the circuit.

An inductor-free bandpass filter that is easy to work with and control. Use it for electronic music chimes, percussion and bell effects, and audio filters.

by DON LANCASTER

three controls do not interact at all, giving you a simple design and easy, flexible adjustments.

Large frequency changes are made by changing both capacitors (C) simultaneously. You get the best dynamic range and stability by keeping both capacitors and both frequency determining resistors (R2 and R2') *equal* in value. Note that a single resistor frequency adjustment is also non linear —you have to change the resistance 9:1 to get a 3:1 frequency change.

With the low-cost 741 and 1558 and 5558 dual op-amps, operation is good to several kHz, even at very high Q's. At low frequencies, stable Q's of 50, 100, and even 200 are easy to get. For higher frequencies and higher Q's, you have to go to a premium operational amplifier such as the LM318.

As long as you use high supply voltages, the circuit performance depends only on the resistors and capacitors, and not on the op-amp or the supply voltage. At very low supply voltages, the circuit can break into sustained oscillation when R1 is very large—this is caused by changing gain and phase shifts inside the op-amps. The effects disappear with 8 volts or more across the op-amp.

Analog computer people will instantly recognize the circuit as an analog of a pendulum. R1 adds "rust" to the hinge and provides damping. For circuit theory people, the transfer function of the circuit is given by the expression

$$\frac{E_{out}}{E_{in}} = \frac{-\frac{1}{R3\times C}S}{S^2 + \frac{1}{R1\times C}S + \frac{1}{(R2\times C)^2}}, \quad S = -j\omega = -i2\pi f$$

and is valid at any frequency where you can neglect op-amp high-frequency performance limitations and where R4=R5.

TABLE
Component values versus Q and Frequency

Frequency	C	Q	R1
10 Hz	15 µF	0.5	5 K
20 Hz	7.5 µF	1	10 K
50 Hz	3.3 µF	2	20 K
100 Hz	1.5 µF	5	50 K
200 Hz	.75 µF	10	100 K
500 Hz	.33 µF	20	200 K
1 kHz	.0159 µF	50	510 K*
2 kHz	7500 pF	100	1.2 meg*
5 kHz	3300 pF	200	3.3 meg*
10 kHz	1500 pF	500	10 meg*

(values approximate—rounded to stock sizes)

(values approximate—*influenced by frequency and supply voltage)

If R3 = 10 K, circuit gain = Q
If R3 = 100 K, circuit gain = Q /10
If R3 = 1 K, circuit gain = 10Q etc . . .

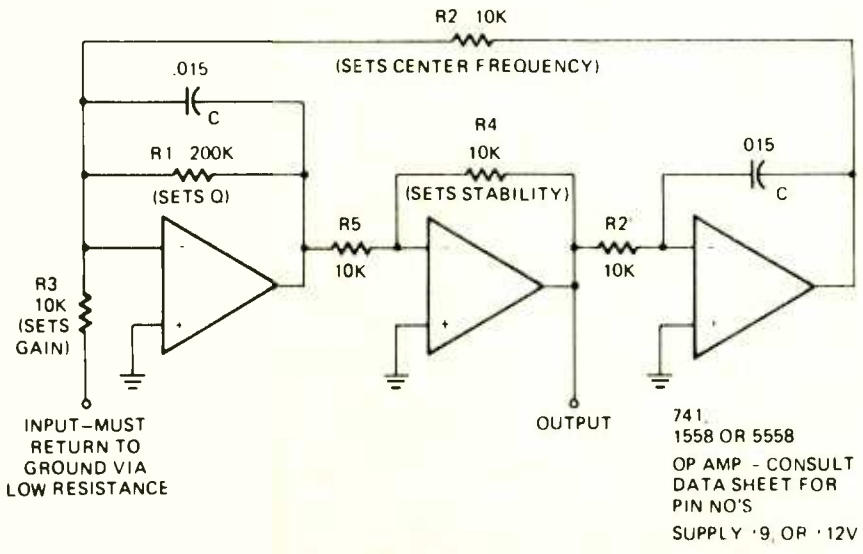


FIG. 2—THE BIQUADRATIC BANDPASS FILTER has op-amps replacing inductors. You have independent control of gain, center frequency, bandwidth, or Q. Values given are for 1 kHz center frequency, a Q of 20 and a gain of 20 at resonance.

Using it—the biquad

Electronic music is an obviously good place to use this circuit. There are three ways the circuit can be used:

As a *filter*, you can selectively pass certain portions of the audio band, do format filtering, or pick out selected harmonics of a complex waveform. Or you can use it to shape noise into a desired frequency distribution or to emphasize a portion of an audio spectrum.

(continued on page 94)

MASTER ANTENNA SYSTEMS

where from here?

by FOREST H. BELT

You were right. MATV business is shifting away from the typical television service dealer. Several reasons grew quickly apparent as I dug into the situation. But it is not too late for the determined shop to get this business back, if he really wants it.

The master antenna business has grown up. A mast-mounted preamp and a few splitters won't feed many receivers, nor adequately process the variety of uhf and vhf signals now available in most localities. I detect an unwillingness in the average TV technician to learn how to install and service sophisticated rf equipment properly.

Again (unpleasant thought) I heard carping against bad workmanship. That's a common fault in MATV systems that don't work well. Shoddy workmanship is more visible than poor engineering, so I heard more about it.

But I've concluded that insufficient engineering creates the major problems with MATV installations. Consider this situation. A school expansion included a TV distribution system. A local television dealer priced a few amplifiers and outlets, a nice broadband antenna and some cable. He made a low bid and got the job. However, the architect's bid specification stipulated a particular signal level, from certain stations, delivered to the room outlets, turned out to be grossly impractical. A survey later showed it would take a 1500-foot antenna tower to find even a snowy signal from two of the stations. The dealer lost his shirt, and a lot of prestige in the town, because he didn't know enough rf engineering to recognize the impossibilities of the faulty specification.

Therein lies the crux of the whole matter. Picking up and distributing multiple television signals demands expertise seldom available in the average television shop. I'm talking about training in mathematics, familiarity with TV station strength, propagation, and patterns, knowledge of antenna characteristics, rf measurement know-how, and experience with the millivolt-reference decibel, with cable losses, with tap isolation, noise figures, and endless interrelationships. Few technicians get this type of training. Without it, laying out and installing a modern MATV system comes close to impossibility.

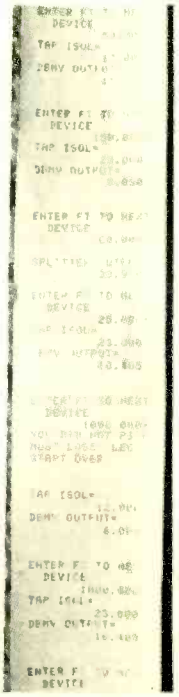
What you can do

Let me take you behind the scenes at a company of the type MATV buyers increasingly turn to. You can study their methods and philosophies. Some of their ideas you can emulate easily. Others may seem beyond you; you'll have to seek ways to meet these challenges. Whatever you do, here's where the MATV business has headed. Read and learn.

Commercial Electronics, Inc., is 14 years old. Its president, Carl Colip, Jr., and its vice president of engineering, B.J.H. Abraham, bring to the firm years of experience in acoustic and communications engineering. They direct most of the MATV and engineering operations. Eighteen specialists comprise the technical staff, including three with engineer training, one with an engineering degree, six with FCC licenses, and seven with State of Indiana Radio/Television Technician and Antenna Installer licenses. Virtually the entire staff has graduated from training clinics offered by MATV, CATV, and sound equipment manufacturers.

CARL COLIP, JR., DISCUSSES SPECIFICATIONS for new MATV system with architect client. Spacious building on U.S. 40 is barely 2 years old.

The company began as an audio systems installer/contractor. But the growth of video as a common adjunct of school, industrial, and hospital communication systems led the company to become "a total systems supplier and installer." A new 12,000- square-foot building a dozen miles east of Indianapolis, Ind. houses a complete MATV/CATV/sound design engineering facility, service and repair shop for audio and video equipment, instrumentation for sound and rf distribution analysis, studios for cable television or sound program origination and recording, and complete installation and system-testing apparatus. Service/installation trucks, as well as execu-



PROFESSIONAL ENGINEER B.J.H. ABRAHAM works out problems for MATV, CATV, and sound installations on Hewlett-Packard minicomputer. This suggests the direction MATV planning and design seem to be taking. Same thing can be done with inexpensive calculator, or even pencil and paper, but not as consistently, conveniently, quickly, or accurately.

THERE'S A NEW TREND IN MATV. Call it professionalism. Master antenna systems are becoming the bailiwick of specialists—commercial firms that deal with architects and builders to design elaborate, competent, and profitable installations.

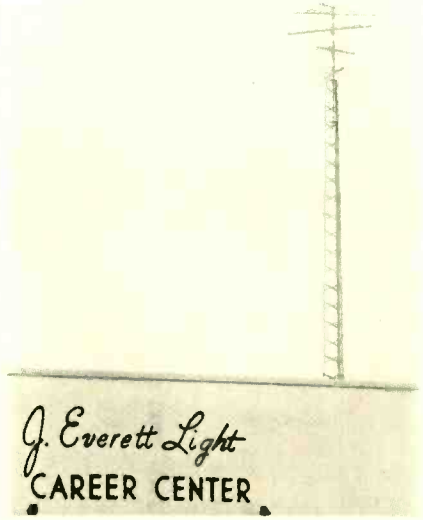
Many neighborhood radio/television dealers are losing their share of this lucrative business.* Radio-Electronics *wondered why. Late last year, we asked writer/photographer (and former editor) Forest H. Belt to investigate for us. Here is his report.

tive cars, are radio-equipped.

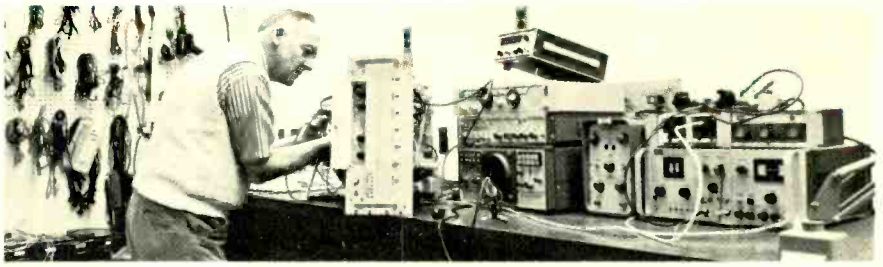
Question: What does it take to get into the MATV business today? Is there room for newcomers? Answer: Yes, there is room. MATV is a burgeoning field. To get in, you need technical know-how. You don't have to be a graduate engineer, but it helps immensely. You must understand rf propagation and distribution. You need a pretty good grasp of math —particularly of logarithmic relationships such as are involved with decibels of gain, loss, and signal/noise ratios. You'll want to comprehend new concepts—two-way distribution channels, data multiplexing, cable TV interfaces.

Colip and Abraham agree that you can obtain practical schooling from the manufacturers of MATV and CATV equipment. Their literature contains a wealth of expert MATV instruction, more than in any textbook. You need lots of basic electronics training before you tackle MATV; you can then learn specifics from booklets, clinics, and seminars furnished (often free) by MATV manufacturers.

But schooling doesn't fulfill the whole requirement. You need experience. If you're determined to go it on your own, with your own business, expect to make mistakes and learn from them. Manufacturers offer help, but you're still on your own when troubles develop. To hedge your bet, work for an established MATV installer a few years and gain experience under the tutelage of experts. Commercial Electronics, Inc., for example, trains their own installers and technicians, having found that no school prepares them for the actualities of putting in rf and sound distribution equipment.



TYPICAL MATV INSTALLATION at school calls for distribution at uhf and vhf, plus two "live" channels for in-house productions, classroom monitoring, even two-way video communication if that becomes necessary.

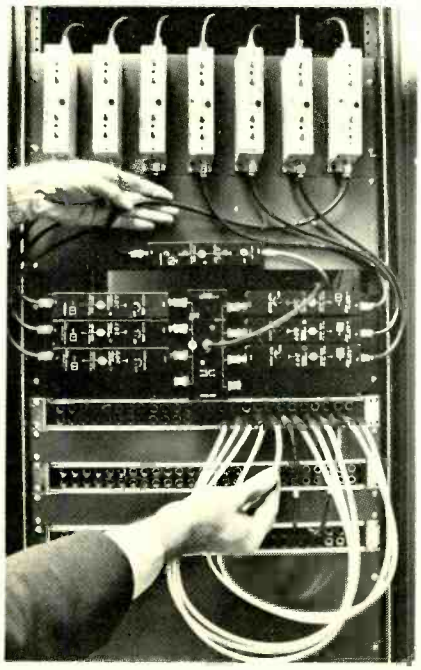


EXCEPTIONALLY EQUIPPED REPAIR BENCH does more than make fixing easy. It also lets specifications be checked on new or unknown equipment, or on fresh repairs to make sure they return unit to full performance.

Finally, entering the MATV business requires investing in test instruments and knowing how to use them. An *accurate* field-strength meter, with ranges that let you measure dBmV (decibels with 1 mV as the 0-dB reference) is likely your key instrument. A reflection-coefficient bridge, a vhf sweep generator, a wideband oscilloscope (300 MHz or so): you'll need these to test cable in runs and in the shop. A set of calibrated rf attenuators; a white-noise generator for signal/noise measurements; and so on. Any competent technician can make all the tests and analyses of rf distribution gear if he has the test equipment and knows how to use it.

What an engineer does

Then why all this talk of engineering specialists? The trend actually is toward companies with engineering *capability*, perhaps in one man. In original design, or in redesigning a faulty installation, true engineering becomes important. Bill Abraham, for example, holds professional engineering registration in several states where the company does business. He designs systems for clients far outside the radius where C-E customarily installs.



His primary tool is a Hewlett-Packard model 9810A minicomputer. No radio/tv dealer is likely to ante up the $5000 or so this instrument costs, so Abraham has this additional edge over the average MATV designer. He has devised programs for every MATV problem and circumstance he can think of. He "writes" each program into the minicomputer and then records it on a small magnetic card. A complicated series of calculations for a multibranch distribution network, once a three-day job with pencil and paper, Abraham does now in a few minutes. The magnetic-card program instructs the computer to ask for whatever data are needed to complete the calculations.

A partial example: Abraham runs a card labeled MATV PROGRAM 2 into the slot. On a paper tape, the computer responds, ENTER MAX DBMV TAP OUTPUT. Abraham punches 20 on the keyboard. The number represents a design decision he must make. The 20 dBmV is the most signal a TV set can optimally handle. The computer records 20.000 on the tape and responds, ENTER MIN DBMV TAP OUTPUT. Another design factor. Abrayam decides he wants at least 6 dmV at this final tap (calculations always begin with the furthest tap on the leg with the most loss). He punches 6 on the keyboard. The computer records it, then calculates the tap isolation figure and displays it on the tape: TAP ISOL = 12.000. It then also displays the signal level that must feed the tap: DBMV OUTPUT 6.000. Then the tape instructs, ENTER FT TO NEXT DEVICE.

This goes on until the signal acquired to feed the tap becomes too large. The tape writes, ADD AMPLIFIER MAX GAIN DB 43.400. Instruction, ENTER GAIN ADDED (the actual gain of the amplifier Abraham decides to use). Maybe the leg reaches the splitter first, at which time Abraham queries

splitter output. The minicomputer has kept track: SPLITTER OUTPUT 33.930. Now the program takes him down the next leg, away from the splitter. All this has taken a minute or so.

The computer program even heads off errors. In one calculation, Abraham came to a point where the leg obviously (to the computer) was too long. The machine typed out, YOU DID NOT PICK MOST LOSSY LEG. START OVER.

Another program delivers approximate figures for station reception. As an example, Abraham wonders if a particular TV station can be included reasonably in a new system he soon will bid on. He inserts the card, and the computer writes, MATV PROGRAM 1. ENTER CHANNEL NUMBER Abraham punches 49. The computer writes, ENTER XMT ANT HT. Abraham consults *Broadcasting Yearbook* for that information and punches the number of feet (above average terrain) on the keyboard: 750. Computer writes, ENTER ERP KW. Maps say 50; Abraham punches it in. The tape rolls a few lines and then prints out: RCV ANT HT 63.5 (line-of-sight over flat ground) SIG LEVEL 6.3 DBMV. That indicates a signal well down into noise—a difficult reception situation, but Abraham decides usable if a noisy (snowy) signal proves acceptable to the consumer.

A few more such manipulations plot each channel within conceivable reception distance. Abraham points out that these are "ballpark" readings, but they help him decide quickly which stations are practical and which not. Engineer-plus-minicomputer make an efficient, dependable combination. Technician and portable calculator come off slower, but not necessarily less accurate. Pencil and paper leave a lot to chance.

Dealing with MATV systems that never work

Commercial Electronics, Inc., experts are often called upon to rescue a system someone else installed but couldn't get to work properly. Bill Abraham runs the system parameters through his minicomputer. C-E technicians know before they arrive at the site how the equipment should perform on each channel. Then they go through and take measurements. A TV set needs 5 to 10 dBmV (around 1500 to 3000μV) of clean signal to show a good picture. If that's not delivered at every outlet, measurements back along the distribution lines track down where the fault lies.

Disappointing results stem frequently from careless workmanship. Frayed outer conductors short the coaxial cable at connectors. Or, a shield fails to ground properly at one end. (*Editor's Note:* The box on this page shows how to install a type-F MATV connector.)

The trouble could be poor signals from the antennas, or a miscalculation along some leg. Sometimes, everything has been designed and wired up properly, yet the system doesn't work because amplifiers are not adjusted correctly. Or an important pad or filter has been omitted. Or measurements were made wrong.

Finding these defects demands experience and equipment. Technicians must actually *look* at crossmodulation, which means they need a modulator and high-frequency scope. They also sweep the coaxial cable runs with vhf generator and scope, checking for structural returns—reflected signals that denote a fault in the coaxial cable. A simple vom can't spot a too-sharp bend, or weak insulation, or a splice in a coax run.

Rarely does an entire installation have to be scrapped, although it does happen. Apartment complexes suffer often, it seems, when owners try to get by cheaply, hiring an inexperienced technician to wire up any kind of equipment. The result seldom serves well.

But you can avoid these pitfalls. Today's "black-box" concept simplifies design. You lean heavily on manufacturer specs. As an example, you need to know the maximum input a particular amp will accept, and how much output it can deliver from a given input. You have to ascertain noise figure, crossmodulation, and skirt characteristics of one-channel amplifiers. You need the gain, noise, agc, crossmod, and tilt peculiarities of broadband amplifiers.

Yet, you can't always trust specs, say MATV installers. "We naturally gravitate to brands we know are rated conservatively. They make us look good when they meet specs, and they last longer." Commercial Electronics, Inc., can—and often does—test "black boxes" for any characteristics they doubt.

You must find out the curve shape of filters you may have to use. Or of pads needed in some antenna downleads or distribution lines. When should you choose a line-powered amplifier, and what kind of taps can you use with it? Who has them?

You ought to know when and how to convert uhf to vhf for distribution, and when not to. Or when to convert a vhf signal to another vhf channel to combat local interference. You learn these things from training, from studying manufacturers' literature, and from experience with systems that demand unusual arrangements to solve specific distribution problems.

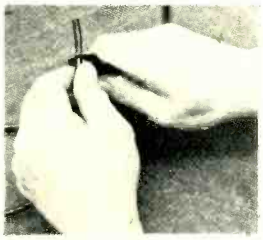
Manufacturers' catalogs are not always complete, either. If you need a special something, always ask. Your favorite manufacturer may have it, yet you may not have seen the literature.

What kind of antennas do experts use? Yagis mostly at vhf, for high gain and front/back ratio. Sturdiness is important, ease of assembly, and coatings for weather

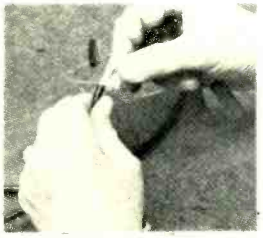
(continued on page 90)

TYPE F MATV CONNECTOR

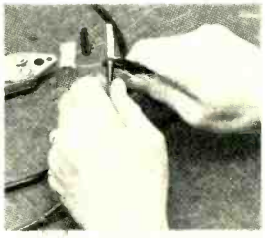
The weakest link in many MATV systems seems to be the rf connectors. They're so often installed wrong or carelessly. The type-F connector is solderless. The inner conductor of the cable forms the center pin. A little concern is all that's needed. Here's how to do it right.



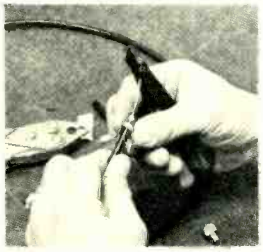
1. Strip off 1 inch of vinyl outer sheath. Special tool helps preserve shielding beneath.



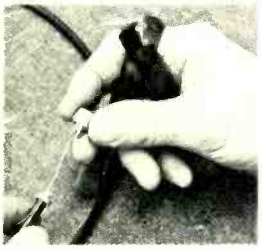
2. Peel off shield foil, but don't damage drain wires.



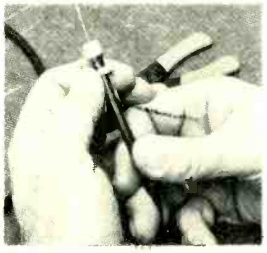
3. Leaving 1/8 inch, strip off inner insulation.



4. Slide sleeve over drain wires, dressing them backward over sheath.

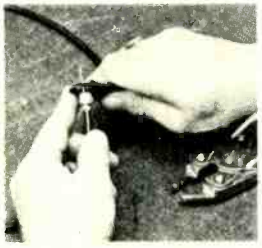


5. Split ferrule of shell and slide onto cable, working split portion under vinyl sheath and into contact with shield foil and drain wires.

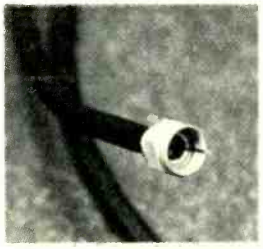


6. Slide sleeve down next to shell, with drain wires under sleeve.

7. Crimp sleeve with crimping tool, pinching drain wires tightly.



8. Leaving 3/8 inch projecting beyond connector shell, snip off center conductor.



9. Coat finished connector with silicone grease inside and out for weatherproofing.

NEW IN CAR ELECTRONICS
3 Clever Circuits

- **Fuel level indicator**
- **Practical CD ignition**
- **IC regulators**

by RUDOLF F. GRAF and GEORGE J. WHALEN*

A COMPLETE LIST OF ALL THE APPLICATIONS of electronics in today's automobile would probalby suprise the average electronic technician by its length. This list is growing steadily as automobile manufacturers continue to add new features and to improve the old. In this article we will review some of the more fascinating circuits.

One of the newer devices to find its way into the modern car is the IC voltage regulator. This device replaces the older electromechanical unit, and also is a drastic improvement over the discrete components electronic regulator.

For example, the typical discrete component transistor regulator uses 24 separate devices and requires 33 internal soldered connections. By contrast, modern IC regulators put more than 40 active and passive elements on a single chip with only 16 welded connections to the pins of the IC.

The IC regulator is fully encapsulated in a high-temperature thermosetting plastic, except for the heat sink surface. This flat metal plate is placed directly in contact with the end frame casting of the alternator. Electrical connection and mounting of the regulator to the alternator is made through the rotor field, ground, and output terminals. No wires are needed or used to connect the regulator to the alternator and only one cable is required to connect the IC regulator to the car battery and electrical system.

Fig. 1 is a block diagram of a typical IC regulator circuit. This regulator consists of three principal units: a voltage-control device, a temperature-compensation network, and an output device to control alternator field current. The voltage-control device includes a resistive divider network, a Zener diode for voltage reference, and transistor amplifier stages. The temperature compensation network can include either a thermistor in combination with resistors, or a network of passive devices and semiconductors. The output device is a Darlington-type cascaded emitter-follower stage.

Since a variety of circuits have been devised to meet IC regulator performance requirements, Fig. 2 shows a typical circuit, rather than a specific design. Most regulators now in use are, with minor differences, quite close to this circuit.

When the ignition switch is closed, voltage is applied to the regulator "exciter" terminal. Current then flows through R3 to the base-emitter circuit of Darlington transistor Q2. It conducts battery current through the alternator field winding to ground. When the alternator reaches the specified output-voltage level, the Zener diode conducts current through the base-emitter circuit of transistor Q1, and it turns on. Current is thus diverted from Q2's base, which turns it off. When Q2 is off, the alternator field circuit is open and the output voltage of the alternator falls.

When the system voltage drops slightly below the tolerance level, the Zener diode stops conducting, turning off Q1, which turns on Q2, allowing field current to flow again. This sequence is repeated as a cycle who's length varies with alternator speed and load conditions to regulate the alternator output voltage within preset limits. Resistors R1 and R2 establish the voltage limits of the regulator, and the value of R1 sets the required operating point.

A transient-suppression diode is used to limit the spurious voltages that are imposed on the IC regulator by the ignition system, and the field-ahsorbing diode is used to supress the transients, that occur during switch-off of the inductive rotor field winding.

Tests have shown that the average life of the IC regulator far exceeds the 100,000-mile mark, with better control throughout its lifetime than could ever be achieved with electromechanical regulators.

*For more on automotive electronics see the book by these authors titled Automotive Electronics, published by Howard W. Sams, $6.95 softcover.

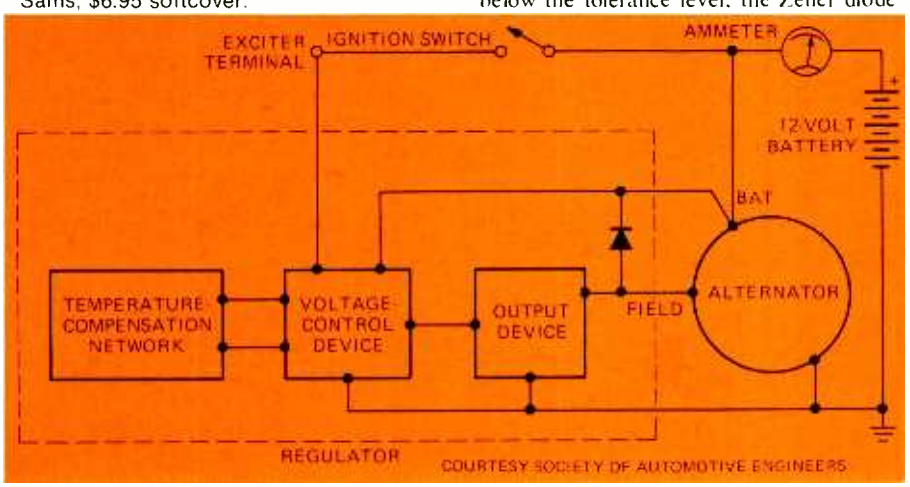


FIG. 1—BLOCK DIAGRAM OF a typical IC regulator circuit used in today's new cars. As you can see, there are three major sections to the system.

Low-fuel indicating systems

A recent optional addition to Ford and Chrysler automobiles is a low-fuel indicating system. It consists of a thermistor assembly attached to the fuel-sensor outlet tube, a low-fuel relay, a 45-ohm ballast resistor in parallel with the relay coil, and a low-fuel-level warning light located on the instrument panel. With a level sensor located in the gas tank, this system is meant to supplement the passive reading of the fuel gauge. The system is diagrammed in Fig. 3. The low-fuel light is factory calibrated so that it will glow when there are approximately 4-½ gallons of fuel in the tank.

The thermistor assembly attached to the fuel-sensor outlet tube is kept excited by a constant flow of current applied through the relay coil and its parallel ballast resistor. This current is sufficient to produce slight heating of the thermistor assembly. The thermistor is so placed that it is constantly immersed in the fuel in the tank. Thus, the fuel acts as a heat sink, absorbing heat from the thermistor and therehy allowing it to remain at a certain equilibrium resistance. If the fuel level falls below the level of the thermistor assembly, the thermistor, now in air, begins to warm up and its resistance decreases. Eventually, thermistor resistance will be low enough that sufficient current flows to pull in the low-fuel-level warning relay, activating the warning light.

Capacitive-discharge ignition

The latest answer (and perhaps the best to date) to electronic ignition systems is the capacitive-discharge system. This system

represents the resurrection of an ignition technology that arose briefly in post World War II days but died in its infancy. As early as 1948, working capacitive-discharge systems had been built, employing thyratron gas tubes and vacuum-tube circuitry. As a result, they were costly, bulky, and unwieldy, not to mention fragile and economically unfeasible. Few mourned their passing. But, viewed in the light of the solid-state advances made in the intervening 20 years, designers foresaw the possibility of reactivating the capacitive-discharge concept, through the use of silicon controlled rectifiers in place of thyratrons, and in adapting transistors to the circuit, building upon their experience in using transistors in ignition systems. From this marriage of an old idea and new components a modern, workable, high-performance system evolved.

Practical CD ignition

A block diagram, and a schematic of a capacitive-discharge system are shown in Figs. 4 and 5. As can be seen from the block diagram, the system consists of a dc-to-ac inverter to change the battery voltage to a higher voltage, a bridge rectifier, a storage element (capacitor), a switching element (SCR), and a high-voltage output transformer (the spark coil) to transform the stored dc voltage to a level that will fire the spark plug.

The dc-to-ac inverter is a familiar transistor-oscillator circuit employing two transistors operating in push-pull. These transistors switch current of a transformer to alternate halves of a center-tapped primary winding. The applied battery voltage is converted from a nominal 12 volts to approximately 285 volts ac by the inverter circuitry (transistors Q1 and Q2, and transformer T1).

This inverter operates as follows: the battery voltage applied to transformer T1 causes current through resistors R1, R2, R3, and R4. Since it is not possible for these two paths to be exactly equal in resistance, one half of the primary winding to T1 will have a somewhat higher current flow. Assuming that the upper half of the primary winding carries slightly higher current than the lower half, the voltages developed in the two feedback windings (the ends connected to R3 and R2) tend to turn Q2 on and Q1 off. This increases the current through the lower half of the transformer winding. The increase in current further drives Q2 into conduction and Q1 into cutoff, simultaneously transferring energy to the secondary of T1. When the current through the lower half of the primary of T1 reaches a point where it can no longer increase, due to the resistance of the primary circuit and saturation of the transformer core, the signal applied to the transistor from the feedback winding drops to zero, thereby turning Q2 off. The current in this winding drops immediately, causing a collapse in field flux, cutting across about the primary winding.

This collapse in field flux, cutting across all the windings in the transformer, develops voltages in the transformer windings that are opposite in polarity to the voltages developed by the original expanding field. This new voltage now drives Q2 into cutoff and

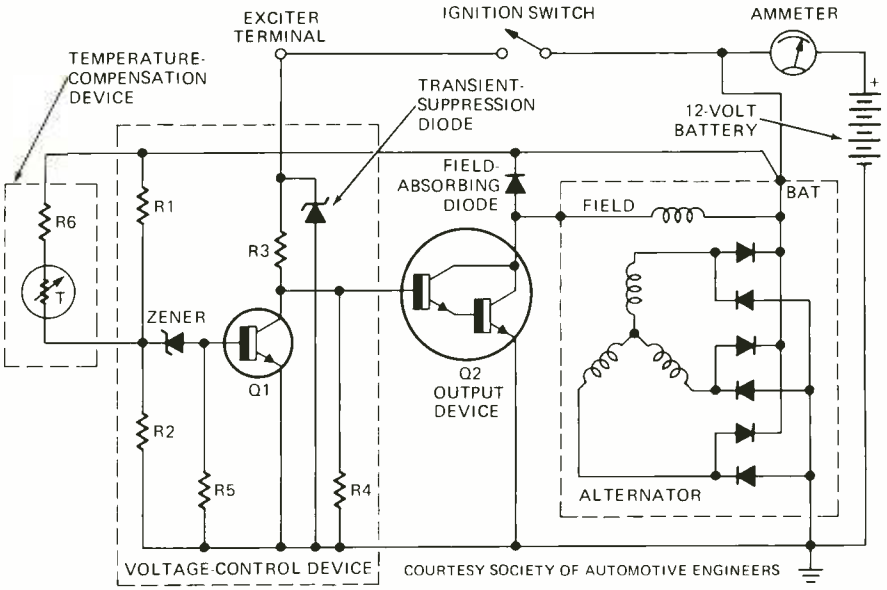


FIG. 2—TYPICAL IC REGULATOR circuit shows actual parts arrangement. Most circuits in use today are very close to this circuit.

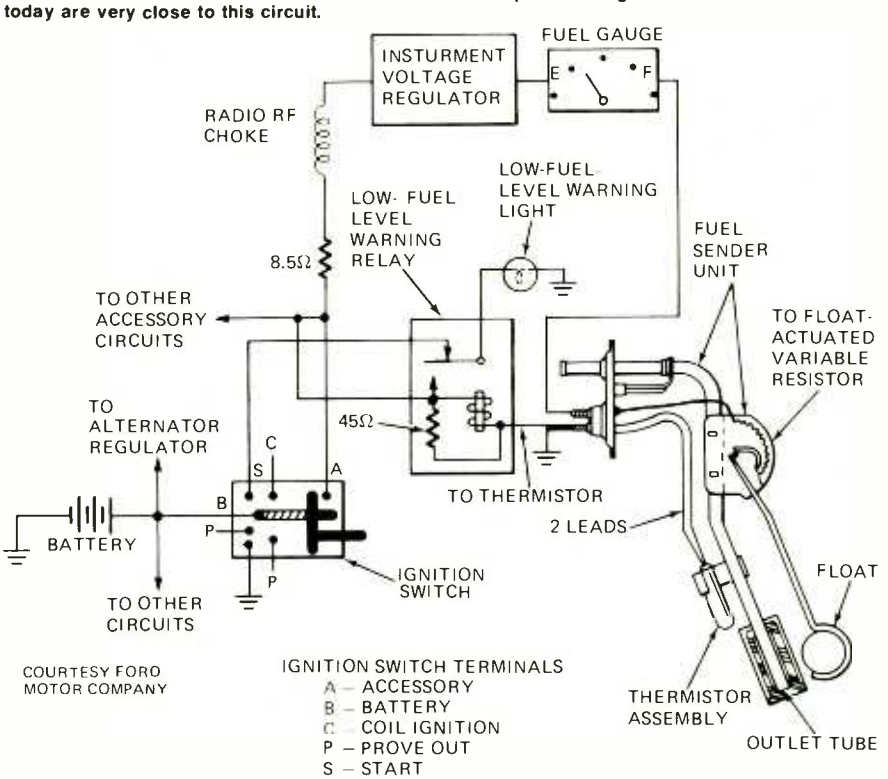


FIG. 3—LOW FUEL WARNING SYSTEM is also turning up in more and more new cars. The circuit is relatively simple once you have a level sensor in the tank.

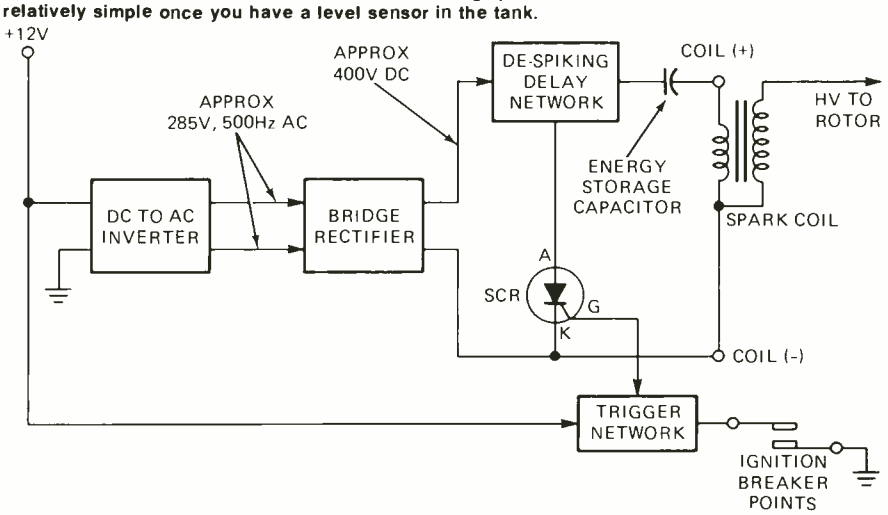
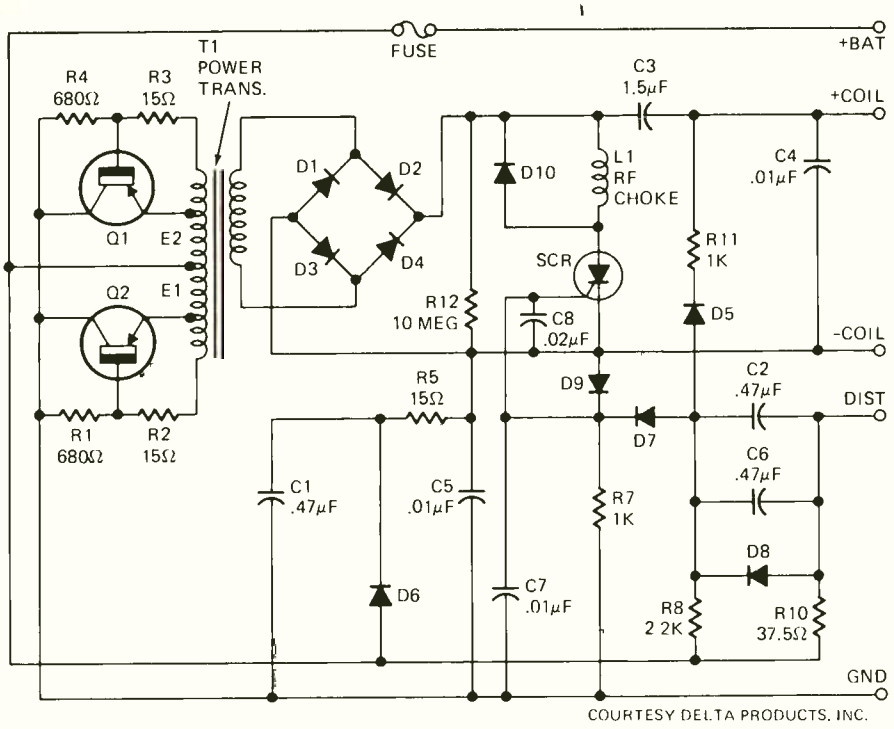


FIG. 4—BLOCK DIAGRAM OF C-D electronic ignition system. Note the dc-to-dc inverter. It is also found in other type systems.



COURTESY DELTA PRODUCTS, INC.

FIG. 5—SCHEMATIC OF DELTA PRODUCTS electronic ignition system. The operation of this circuit is completely detailed in the text and covers the action of most capacitive-discharge type systems.

excites Q1 into conduction, simultaneously delivering power to the secondary winding, which is connected to a bridge rectifier circuit. This action continues until saturation is again reached, and Q1 ceases to conduct, which regeneratively turns on Q2 via coupling through the feedback winding.

It should be understood that this action occurs at a frequency of aproximately 500 Hz — the frequency being determined by the saturation characteristics of transformer T1. The 500-Hz square-wave current through the primary of T1 causes approximately 40 times the applied potential to appear across the secondary winding of T1. This high induced voltage is applied to diode bridge D1 through D4. The rectified dc output from the diode bridge circuit is about 400 volts, which is applied to capacitor C3 through the spark coil primary. This action takes place as soon as power is applied, i.e., when the ignition switch is closed. Simultaneously, battery voltage is applied to the breaker-point circuit through resistor R10 and to the SCR through diode D6 and resistor R5, with capacitor C1 serving as a filter to prevent false triggering by noise transients.

As the first piston comes up on the compression stroke and reaches the position where the spark plug should be fired, the points open. The current available at the junction of R10 and D8 now flows through C2/C6 and D7, appearing as a pulse across gate resistor R7. This pulse switches the SCR on by triggering the gate lead. When the SCR turns on, two things happen simultaneously.

First, the SCR short-circuits the power-supply diode-bridge output, with the effect that the short is reflected to the primary T1, removing feedback drive from transistors Q1 and Q2 and instantaneously stopping inverter oscillation. Second, the SCR switches the positively charged plate of C3 to the negative spark-coil primary connection. This forms a closed circuit consisting of capacitor, SCR, and the coil primary.

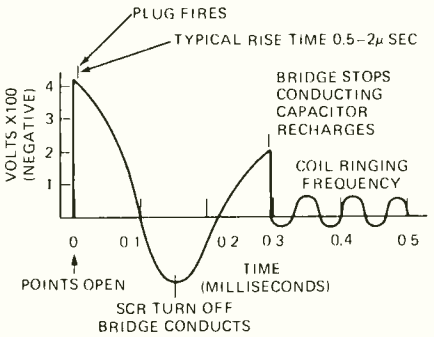


FIG. 6—WAVEFORM SHOWS SPARK delivered by the C-D ignition system.

The energy stored in the capacitor is now "dumped" into the spark-coil primary. The primary voltage of the coil rises from zero to 400 volts in approximately 2μs (see Fig. 6).

In the circuit made up of the SCR, capacitor, and spark coil, a resonant circuit is formed between the primary winding inductance and capacitor C3. The flywheel effect of this circuit restores unused energy to the capacitor discharge current flowing through the SCR and coil primary, creating a magnetic field in the coil. This current continues to flow in the circuit until the capacitor is charged in the reverse direction to approximately 300 volts. At this point, the current attempts to reverse through the SCR, causing the SCR to commutate (switch to its off condition). The reverse voltage now causes the diode bridge to conduct as a short circuit (all diodes simultaneously in the conduction mode), thereby draining the reverse charge accumulated in C3. When the current supplied by the coil inductance again drops to zero, the load is removed from transformer T1, and inverter operation resumes, since feedback is now available to start the transistors oscillating.

Diodes D5 and D8, in conjunction with resistor R11, serve to discharge triggering capacitors C2/C6 completely when the SCR turns on. Diode D7, resistor R8, and capacitor C7 prevent erratic triggering caused by point-bounce at higher rpm. Diode D10 and rf choke L1 form a despiking and delay network (L1, D10) used to limit the turn-on current through the SCR when C3 discharges.

The inverter circuit and bridge rectifier will deliver full energy to capacitor C3 at engine speeds exceeding 8000 rpm. Between spark pulses, the inverter has plenty of time to recharge the capacitor. Since total system current drain is low, the CD ignition system normally operates with the ballast dropping resistor already present in most conventional ignition systems. In contrast to a transistor system this eliminates the need for rewiring the vehicle and/or adding an ignition relay. One of the principal advantages of the CD ignition system is its ability to provide full peak-pulse starting spark to the engine — especially to a cold engine in sub-zero weather. Since the system depends upon dumping a stored energy quantity, rather than operating from the very low 12 volts available in the car from the conventional electrical system, it is easy to understand that substantial pulse output can be obtained even when the starting motor is robbing battery terminal potential and decreasing it by as much as 3 volts as it attempts to crank a stiff, cold engine.

Another important characteristic of the capacitive discharge system stems from its use of a silicon controlled rectifier. Remember than an SCR will conduct when its gate is first triggered by an input pulse, this means that the SCR turns on and remains on so long as holding current is flowing through it. Hence, the CD ignition system is self-completing, once an initial input pulse has triggered the SCR into conduction. The circuit will dump its stored capacitor charge through the ignition coil and will continue to drain it dry until the SCR is turned off by the collapse of the pulse current back into the primary of the ignition coil. This means that dirty, worn, or contaminated points do not degrade the spark energy available to the spark plug. This significant feature contrasts with the all-important need for clean, low-resistance point surfaces in conventional and transistor systems. The SCR gives a clean, definite switching action of the type which Mr. Kettering sought so far ahead of the invention of this device. This "single-trigger" characteristic of the system allows good ignition performance with ignition breaker points that could not be used in either a conventional or transistor ignition system, because of high contact resistance or general degradation. To guard against multiple firing of the SCR because of point bounce at high speed, a delay of approximately 1μs is provided in discharging capacitors C2 and C6 when the points close. This slight delay desensitizes the circuit to point bounce problems.

Unlike the transistor ignition systems discussed earlier, which require the removal of the distributor breaker-point shunt condenser, the CD ignition system operates either with or without the presence of this component. If left connected, the only effect of this shunt capacitance is to reduce SCR gate firing current when the points open. However, the system is designed, in general, so that more than twice the maximum required turn-on current is available to the SCR gate with the condenser installed across the breaker points. **R-E**

CATV TROUBLES,

With CATV entering more and more homes, the possibilities developing in the cable system may be mistaken for set

by JACK DARR
SERVICE EDITOR

IN THE SEPTEMBER 1972 SERVICE Clinic, we went over some of the more common troubles found in TV sets used on CATV systems. In that article, I was trying to help you identify the trouble—find out whether it was in the set or the cable. I was a little optimistic, because in my town we have a very good CATV system, which has very little true "cable trouble."

From talking with field engineers from several TV manufacturers and from correspondence with expert technicians in many states, I have found that, in certain places, there really *are* cable problems! So, herewith a follow-up, based on a study of the systems used in CATV, and some of the problems that are encountered. You can identify these without too much trouble, and deal with them. They *do* happen!

Cable systems

Cable TV systems, like Gaul, are divided into three parts. (Should have said "types," but I couldn't resist.) The original systems used a group of antennas on a mountain top, where they could get a strong signal. Each one fed a single-channel preamplifier, the *head-end preamp*. The outputs of these were fed to a wideband amplifier, down the *trunk* cable, and into the distribution system. This used *line amps* at regular intervals, when the signal level dropped below the standard.

That approach worked pretty well. However, there were problems; fading, crosstalk between adjacent channels

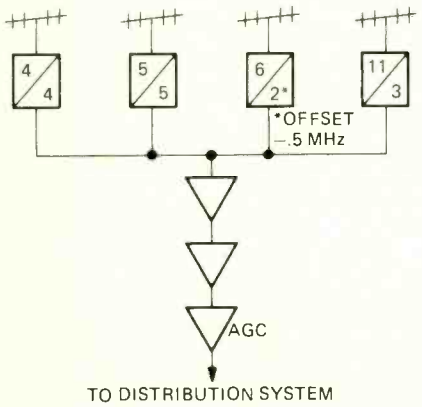


FIG. 1—OLD STANDARD TV HEAD END with one amplifier for each channel and conversion from the high to the low-band vhf channels.

(TV tuners are *not* noted for their razor sharp selectivity!), and worst of all, very high loss on the high-band vhf signals. This is twice as great as the loss of low-band signals. To help this, they used a converter system. Figure 1 shows a typical example of one.

Here we have four channels: 4, 5, 6 and 11. Channels 5 and 6 are adjacent: run at a high level in the cable, so 5 sound interferes with 6 picture. So, channel 6 is converted to channel 2. Now we have no adjacent channels, since there is a 4-MHz gap between 4 and 5. To get rid of the high losses on channel 11, it is converted to channel 3. The channel 2 carrier is "offset" low, by about 0.5 MHz, to help clear adjacent-channel interference with channel 3. This worked pretty well, but confused a lot of subscribers who could not figure out why "I get channel 11 on my set on 2!" etc.

There were signal-strength problems, too, due to fading up or down. The normal answer for this was to add agc to the amplifiers. This helped, but caused a few other problems (naturally)! Automatic gain control works on the peak signal voltage. So, if you have four TV signals going through a wideband amplifier, as in Fig. 2., the agc is

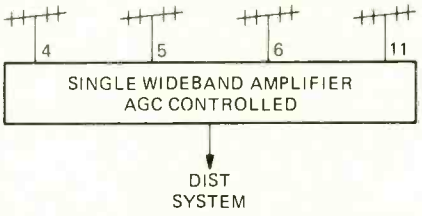


FIG. 2—SINGLE WIDEBAND AMPLIFIER is simpler and cheaper, but has some disadvantages.

going to operate on the highest signal level. Suppose you have a situation where channel 4 is a very strong signal and channel 6 very weak. Then, if the channel 4 signal increases, down goes channel 6 into the mud! This, of course, is in systems where the agc is used on a single wideband amplifier carrying all four channels.

The second version

Up to this point, aside from converting and using gain controls, there was no real "tinkering" with the TV signals. They were converted, but the same process is used in all TV tuners, except that the output was on another low-band channel instead of on a standard TV i.f. Now, however, a different system was tried out, and this is the one that seems to be causing the most trouble.

It is called "demod/remod," which means that the TV signal is demodulated at the head end, then remodulated onto a fixed-level carrier as in Fig. 3. The idea was to get all signals

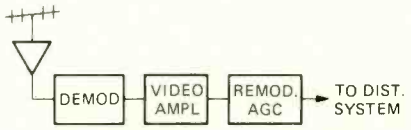


FIG. 3—THE DEMOD/REMOD APPROACH

into the system at the same *rf carrier level*, to make the task of agc control easier. There were also disadvantages here.

In the demod-remod processing, there is a loss of modulation *percentage* on the signal! Under worst-case conditions, the signals could be distorted, so that the normal 75-to-25% video-sync ratio would be upset. In most of these, the maximum modulation percentage was only about 85%. It can also compress the signal, with the inevitable clipping of the vertical sync.

Any slight misadjustment of this system, and you get subscriber complaints— "My picture's good, but it rolls all the time!" (Loss of sync amplitude gets the vertical first.) The only real cure for this would be a setup like that used in a TV station, where an operating engineer sits at a console at all times, watching a monitor scope that displays nothing but the sync/video ratio! (And if *that* monitor gets out of calibration, you've got real problems, believe me.) For four channels, this could mean a monitor and operator for each, which would get expensive, especially in the smaller systems.

The latest version

To get rid of the inherent problems in the first two versions, a new one was developed. This has all of the advantages but none of the disadvantages, of the earlier ones. This is sometimes called a "beat-down/beat-up" system. The signal can be converted, and the rf carrier level fixed or varied (offset) if necessary, but the signal is *not* demodulated.

Instead, it is beat down, by mixing it with a fixed oscillator, just as in a TV

and how to pin them down

are great that video, sync or color troubles symptoms. Here is how to identify them.

tuner. This gives us an i.f. signal, which is amplified and then beat back up again. Agc can be used on the i.f. if desired. The beats are produced with the same oscillator, if the signal must come out on its original channel frequency. The output carrier level is fixed, so that all signals go into the system at the same level.

Before this, though, special head-end preamps are used, giving a dual agc action. These cover the whole vhf band, both low and high. At the input and output of each one is a bandpass filter for the channel on which it is used. The amplifier has very high gain, and is agc-controlled. So, the agc in this amplifier works only on the signal level of its own channel, and can be adjusted to make each one come out, for feeding the beat-down-beat-up amplifier, at exactly the same level. Ample reserve gain is provided so that these amplifiers will never be driven into clipping.

The main head-end ampifier feeds the trunk cable. This in turn feeds the distribution network, with line amps at whatever intervals they are needed. These can be agc-controlled, too. The idea of this, in a correctly designed and operated cable system, is to deliver each channel signal to the "house-drop" (subscriber's TV set) at a level somewhere between 1000 and 1500 μV. This will give an ample signal-to-noise ratio and a snow-free picture.

Identifying cable troubles.

At any rate, here we are again, where we were in September 1972—in the customer's home. The color set has vertical jitter, over-contrasty pictures and poor sync (or something). How can we separate real cable troubles from set trouble? There is always a chance of agc or noise-canceller problems in the set. It may work very well on a 300-μV signal from an antenna, and go to pot on a 1500-μV signal from CATV.

The simplest answer, again, is our "substitute cable" or bar-dot generator. Most of these have rf output on at least one low and one high channel. Some cover then all (vhf). The rf output is high, often up to 200,000μV. You need a calibration of this output, on at least one channel. This doesn't have to be too precise; just get in the ballpark, between 1000 and 1500 μV. You can do this on a field-strength meter. Mark the panel so that you can reset the attenuator.

Feed this into the set, on a cross-hatch pattern. If there is any jitter or sync-clipping, this will show it up. The horizontal bars will quickly show up any tendency to vertical jitter, and vertical bars any horizontal sync problems. If the pattern is rock-steady, as it should be, at this input level, the set is cleared, and you can blame it on the cable!

For definite proof, you can read the detected video signal at the set's video detector output, on a scope. At this point, it should have the normal 75/25% video-sync ratio. Check it on all channels; while the amplitude may change slightly, the sync/video *ratio* must not. Figure 4 shows what you ought to see

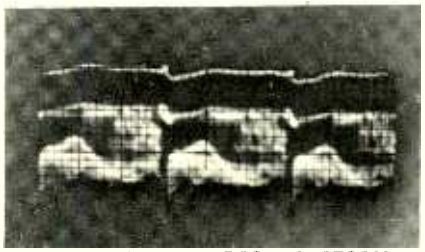


FIG. 4—A NORMAL VIDEO WAVEFORM as seen at the video output, is 25% sync, 75% video.

here. The scope does not have to be calibrated; all you need to do is set the vertical gain for four divisions of the graticule, and see where the black level is; the dividing line between sync and video. Sync compression is very easy to see.

One other possible problem is hum bars, or bending and weaving in the picture; no hum bar in blank raster, or on bar-dot signal. A single bar can be due to heater-cathode shorts in one of the tubes in the nearest line amplifier, if the system still uses tube-type amps. Two hum bars could be due to an open filter capacitor in the power supply, in either type.

The next step.

After you have proven, at least to your own satisfaction, that there *is* a "cable problem," the next step is to get in touch with the cable system technicians. In most cases, they'll be ready to cooperate with you in finding the cause of the trouble.

Find out what kind of system they use. If it is one of the older systems, they may have some old coax., line amps, and so on. These can cause clipping problems. Or, are they using the demod-remod system, and losing modulation percentage?

If there are problems, and they should refuse to do anything about it, all you can do then is try to organize a "consumer protest." I don't mean marching up and down in front of the cable office with signs reading "Down With Fizzy Pictures!" or "Our Sync Has Sunk." Something like an organized letter writing campaign ought to do it.

Frankly, I don't believe that there are too many cable-system operators who intentionally let their systems run down. Their living depends on having satisfied customers! Engineering advice on the subject is always readily available from all of the companies who build CATV equipment. In fact, any really competent technician can make the tests and measurements, and detect real problems, with the methods just outlined. **R-E**

BENCHTOP YOKE PROTECTOR

Save yourself money and extra work by protecting those fragile windings of TV deflection yokes from the rough edges of brackets and angles on the rest of the chassis when doing bench work. An effective yoke protector can be easily made from a plastic one-quart detergent botttle—just snip off the upper portion of the bottle with a sturdy knife

or scissors. Smaller-sized plastic bottles can be used for those small-screen black-and-white portables.

Cut the plastic bottle on a diagonal, then the yoke protector can be turned around to provide the most protection and still accomodate the longest or shortest yoke-lead lengths.—*Elmer Carlson*

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BUILD

Automatic Noise Eliminator

Tired of kicking up the volume control to overcome noise on a busy road, then having to turn it down again when everything is stopped for light? This Automatic Noise Eliminator solves the problem.

by LARRY WILSON

THIS "SET-IT-AND-FORGET-IT" NOISE eliminator automatically maintains your car radio volume proportionally above the noise level whether on the freeway at 6:00 pm or a residential street at 6:00 am. The Automatic Noise Eliminator eradicates the effects of wind noise, road noise, engine noise, (even back seat driver noise!) by turning up the radio volume to overcome it. If the noise level goes down, radio volume goes down a matching amount.

What this means to you is: at freeway speeds the radio is loud to overcome wind, road, and engine noise and (without twiddling any knobs!) quiet, docile, and non-blare when stopped at the traffic light. This is a true automatic control system that can be built inexpensively in an evening or two.

How it works

The automatic noise eliminator is an automatic feedback control system that compares a wired-in signal to an acoustically coupled signal containing both program and noise, then adjusts radio loudness to maintain a fixed signal-to-noise ratio for the listener. Fig. 1 is a functional block diagram and Fig. 2 a schematic of the instrument.

A pickup—in this case a 2-inch permanent magnet speaker—is placed near the driver and "listens" to whatever the driver hears. Q1 and Q2 amplify the audio from the pickup. The network consisting of C4, D2, D4, C5 and R7 converts the audio into a dc level proportional to the average sound intensity at the pickup. Note that the pickup is exposed to the same environment as the radio listener and "hears" both the radio program, or S, and the combined road, wind, and engine noise, N. The dc level from C5 to ground is proportional to S + N.

The reference or feedback channel is brought into T1 by wires connected across the radio speaker. T1 steps up the audio voltage so it can be rectified and filtered to obtain a dc level proportional only to S. D1 and C3 are arranged to make the wired-in signal negative with respect to ground. At C5 we have a dc level proportional to S + N, and at C3 a dc level proportional to –S. These signals are summed at the base of Q3 to produce (S + N) + (–S) = N, a signal proportional only to the ambient noise.

The signal at Q3's collector, then, is proportional to the ambient noise. Q3 drives emitter follower Q4 which in turn drives the lamp/photocell module PL-1. The photocell (photoresistor) is connected across the radio's volume control (through R16) in voltage divider fashion such that the brighter the lamp the lower the photocell resistance and the lower the volume. With no noise at the pickup, Q3's collector will be at supply voltage and the lamp will be its brightest. As ambient noise increases (such as by revving the engine or by driving away), the amplified noise signal drives Q3's collector toward ground reducing lamp current in Q4, increasing PL-1 photocell resistance, and increasing radio volume. The rate at which volume changes in the presence of noise is controlled by the load on Q3. R12 is adjustable to make the radio volume "track" the noise to maintain the selected signal-to-noise ratio over the ambient noise range.

R8, R9, R10, R11, C6, and C7 establish time constants long enough to prevent volume fluctuations due to silences and pauses. The ratio of R9 + R11 to R8 + R10 sets the signal-to-noise ratio (and dynamic range). R6 allows the –S signal to be balanced with the +S signal to assure that the N signal is all that is amplified by Q3. R1 and D3 compensate the base-emitter forward voltage drop to provide true class-B operation over the temperature range. Q5 and R12 reduce collector voltage drift with tempera-

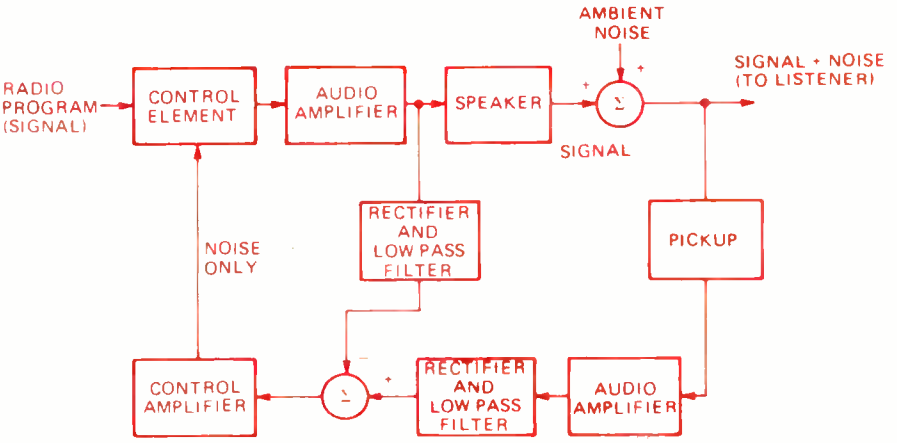


FIG. 1—HOW THE ELIMINATOR WORKS. The microphone at far right picks up a mixture of noise and signal, amplifies and rectifies it. The signal is subtracted from the noise, sending a pure noise signal to the control amplifier. The control element then turns up volume as ambient noise increases.

ture by functioning as an active load for Q3 that varies with beta variations.

Since the radio's volume control is rendered ineffective R16 is added to control the static or noise-free volume.

Constructing the eliminator

The noise eliminator can be assembled on the printed-circuit board shown in Fig. 3, or on Vector board using the layout shown in Fig. 4. Layout is not critical but it is a good idea to keep the speaker and volume control circuits separated to prevent feedback. Use shielded cable throughout for the radio volume control circuit, and make sure that the phono plug does not ground against the chassis. The feedback control (R6 and the tracking control R12) should be mounted "up front" for ready access, as the final adjustments are best made with the eliminator installed in the car.

Mount the speaker (pickup) in a plastic lid from a medium sized aerosol can, as shown in Fig. 5. The base shown in the figure is carved from wood and painted. You can also make the PL-1 module yourself (Fig. 6). Choose a CdS cell that has a 1-megohm minimum dark resistance, and a lamp rated at about 10 volts. Photocell resistance should be about 500 ohms with 12 to 15 mA flowing through the lamp.

Installing the unit

Since R16 replaces the radio volume control, the noise eliminator should be mounted in a handy location, such as under the dash near the driver, so pickup and driver "hear" the same things. If possible, the pickup should be exposed to the wind noise (if wind noise is to be eliminated). A good location is on the console or drive shaft tunnel between the bucket seats. You *can* hide the pickup under the front seat, but this tends to shield it from wind noise and will reduce effectiveness.

Use double-sided transparent or masking tape to keep the pickup from sliding about. (It's important that the pickup doesn't move once adjustments have been completed). Miniature audio zip cord connects the pickup to the circuit board inconspicuously.

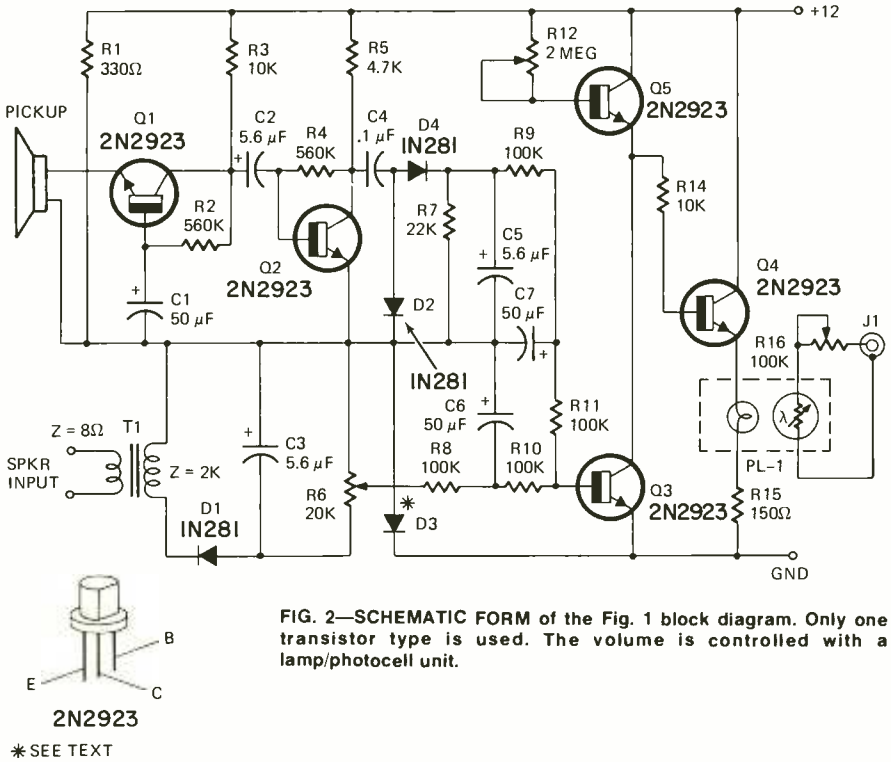


FIG. 2—SCHEMATIC FORM of the Fig. 1 block diagram. Only one transistor type is used. The volume is controlled with a lamp/photocell unit.

PARTS LIST

R1—330 ohms, ½ watt
R2, R4—560,000 ohms, ½ watt
R3, R14—10,000 ohms, ½ watt
R5—4,700 ohms, ½ watt
R6—20,000-ohm trimmer potentiometer, linear taper (Mallory MTC24L1 or similar)
R8, R9, R10, R11—100,000 ohms, ½ watt
R12—2-megohm trimmer pot, linear taper (Mallory MTC26L1 or similar)
R15—150 ohms, ½ watt
R16—100,000-ohm pot, audio taper
C1, C6, C7—50 µF, 6 V, electrolytic
C2, C3, C5—5.6 µF, 25 V, electrolytic
C4—0.1 µF
D1, D2, D4—1N281 or similar general-purpose *germanium* diode
D3—Any general-purpose *silicon* diode
J1—RCA phono jack
Pickup—2-inch PM speaker, 80-100 ohm voice coil
PL-1—Vactec VT10030 Vactrol photocell-lamp module. See text and Fig. 6.
Q1 through Q5—2N2923
T1—miniature audio output transformer, 8 ohm secondary, 500–2,000-ohm primary.
Miscellaneous—4 x 2¼ x 2¼-inch utility box, miniature audio zip cord, etched circuit board.

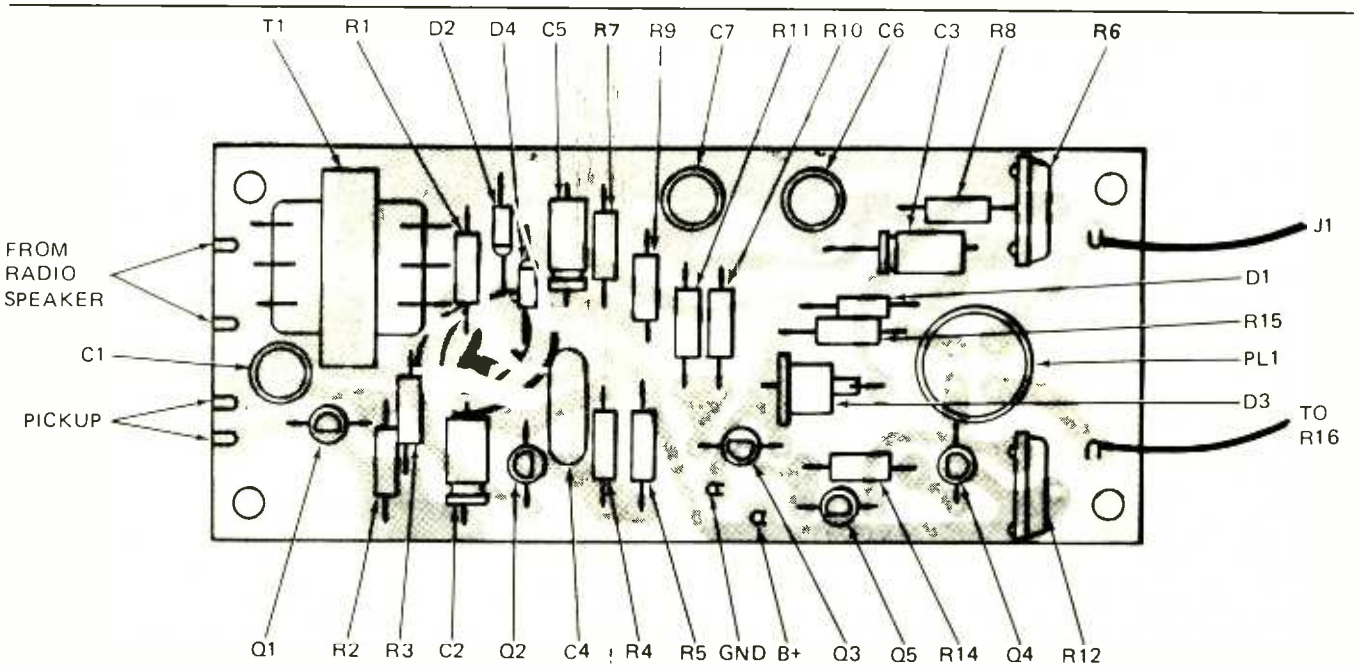


FIG. 4—TOP SIDE OF THE PC BOARD. Parts placements is clearly shown.

Once the eliminator is in place connect the two wires from T1 to the radio speaker terminals. Connect the power leads (B+ and ground) to the switched side of the ignition switch. If possible, tap into the same wire that powers the radio and after the fuse. For positive-ground cars simply observe the proper polarities when installing.

Radio modification

Your car radio requires a minor modification to work with the noise

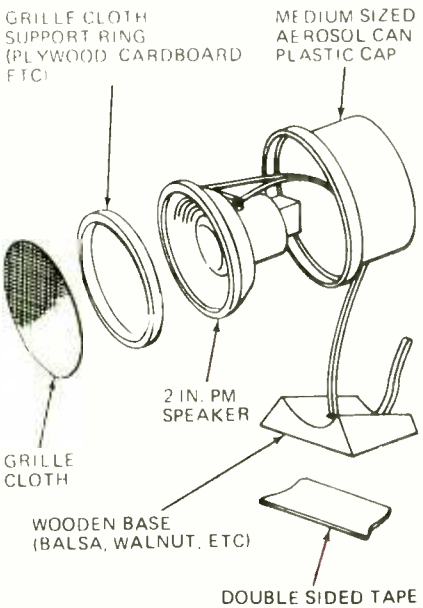
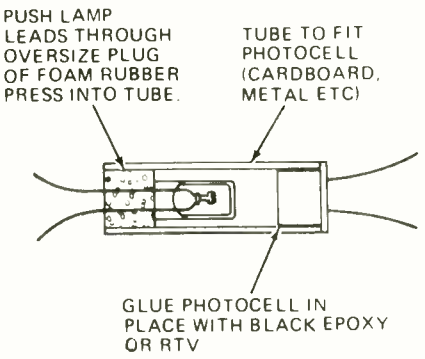


FIG. 5—THE MICROPHONE PICKUP is actually a small loundspeaker mounted in the top from an aerosol spray can.

eliminator. Remove the radio from the car and expose the volume control. Basically, there are two types of volume control circuits used by the different manufacturers, as shown in Fig. 7. For many radios simply connect the inner conductor of a shielded cable to the volume control wiper (center terminal) and the shield braid to the low side (left hand terminal looking at the rear of the control). *Do not let the shield braid touch chassis ground!* Delco radios require different treatment. Add the resistor-capacitor net-



NOTE:

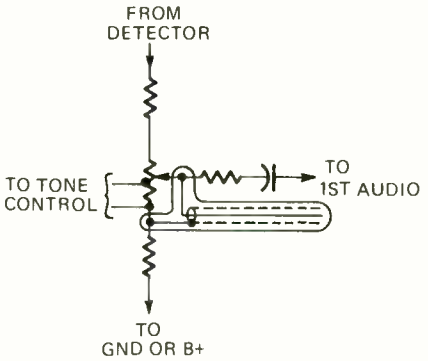
CHOOSE A CdS TYPE PHOTOCELL THAT HAS A 1MEGOHM MINIMUM DARK RESISTANCE. THE LAMP AND PHOTOCELL COMBINATION SHOULD GIVE 500 OHMS CELL RESISTANCE WITH 12 15 MILLIAMPS FLOWING THROUGH LAMP. THE LAMP SHOULD BE RATED AT ABOUT 10 VOLTS

FIG. 6—YOU CAN MAKE YOUR OWN photocell unit if parts are available.

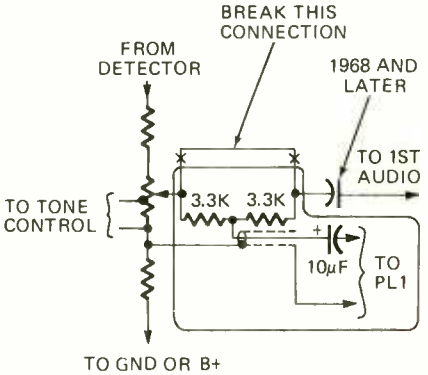
work noted in Fig. 7. If there is room in the radio, you may want to install an *insulated* phono jack for later plug-in convenience. Otherwise, attach a phono plug on the free end of the cable. Make sure the cable is long enough to plug into the installed eliminator.

Initial adjustments

First adjust feedback pot R6. With power applied to both the radio and the eliminator and R12 set at about midrange, turn up the radio volume control almost to maximum (if the eliminator is working properly, the volume control should have no effect until nearly at maximum). Back the control up slightly when volume does begin to increase. Whistle steadily into the pickup and adjust R6 with an insulated tool until the volume slowly increases then levels off and then decreases as you whistle, then stop. Should radio volume increase exponentially to maximum loudness adjust R6 for more negative feedback until the eliminator "takes hold" and cuts volume back. Use a portable FM radio tuned between stations for a noise source rather than whistling if you like. Now set the tracking control R12 until the volume gets louder and louder *smoothly* as the noise increases. Improper adjustment of R12 will



7-a) TYPE 1 VOLUME CONTROL ARRANGEMENT. USED BY FORD, CHRYSLER CORP., RAMBLER. SIMPLY ADD THE SHIELDED CABLE (SHOWN CIRCLED). DO NOT LET THE SHIELD BRAID TOUCH CHASSIS GROUND!



7-b) TYPE 2. USED BY GENERAL MOTORS. ADD THE TWO 3.3K RESISTORS INSIDE THE RADIO, THE 10μF CAPACITOR INSIDE THE NOISE ELIMINATOR. THIS METHOD IS SATISFACTORY FOR NEARLY ALL RADIOS AND CAN BE USED WHERE ANY DOUBT EXISTS ABOUT CIRCUIT TYPE.

FIG. 7—CAR RADIO VOLUME CONTROL arrangements. 7-a is used by Ford, Chrysler and Rambler; 7-b is the circuit in G-M cars, and shows the modifications necessary for them, or for radios where the circuit type is uncertain.

cause the volume either to lead or lag the noise more and more as noise increases. This adjustment is perhaps best made during a test drive (take a friend along and let *him* adjust while *you* drive for safety's sake).

Properly adjusted, the noise eliminator will keep you happily listening to an auto radio that is always at the proper volume whether blasting down the freeway with the top down or creeping through downtown traffic waiting for the lights to change. **R-E**

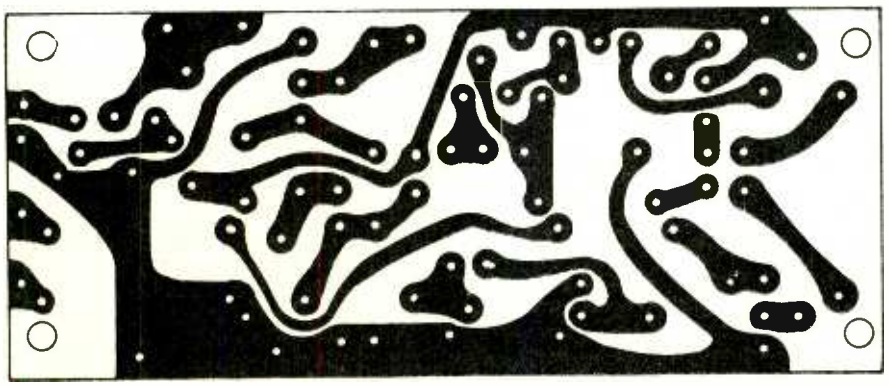


FIG. 3—FULL-SIZE CIRCUIT BOARD. You can copy it or use your own layout on Vector or Vero board.

AD CORRECTION

In the Leader ad which appeared in both the October and December 1973 issues, the price shown for the LSG-231 FM multiplex stereo generator was incorrect. The correct price should have been $299.95.

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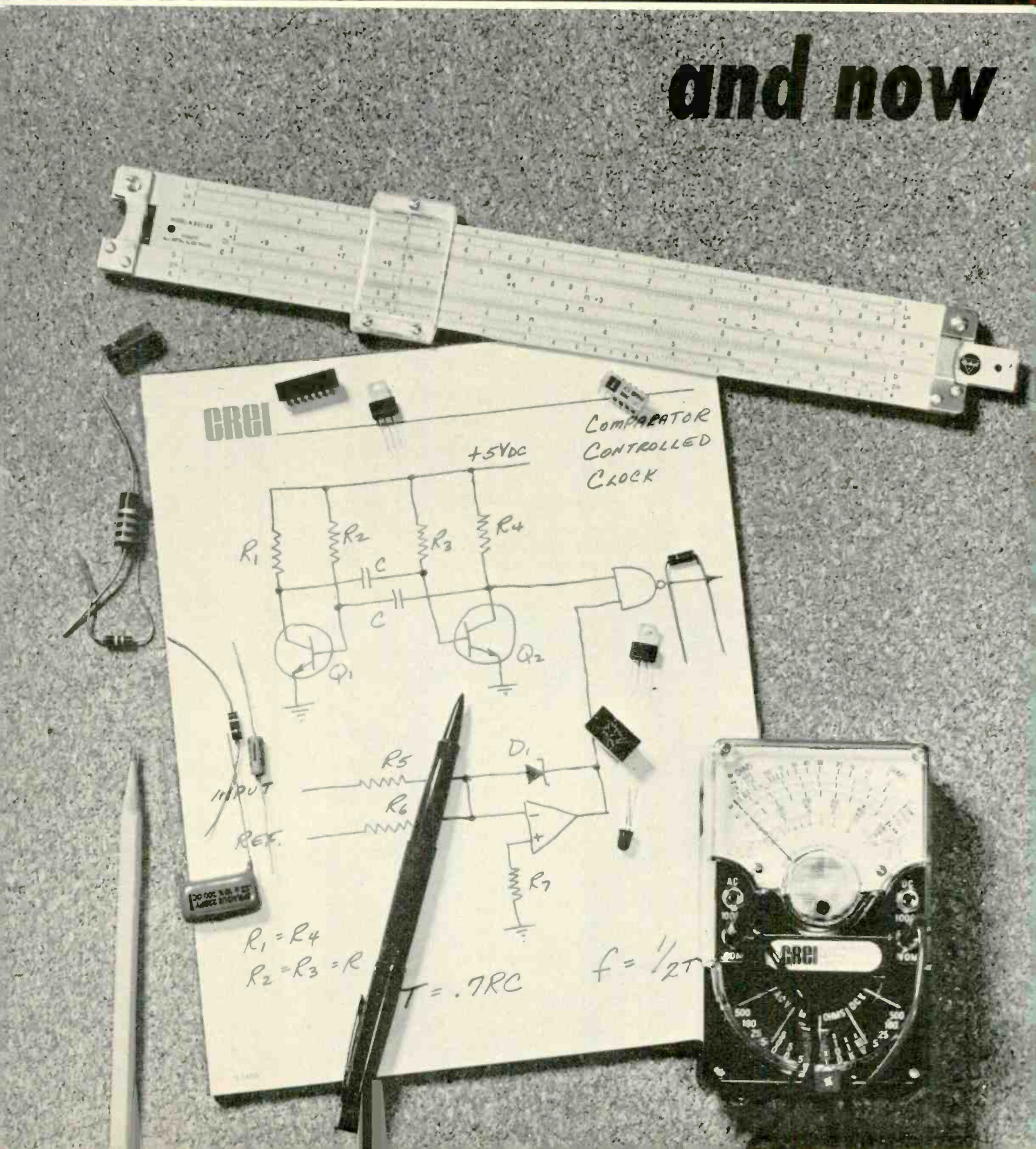

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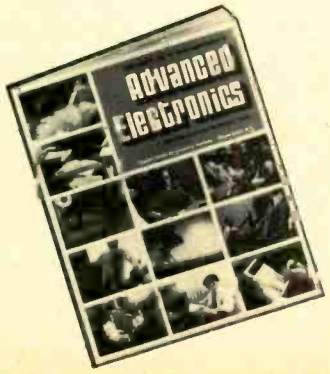

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R-E's Service Clinic

The Variac—a handy servicing aid

Catch intermittents by juggling the supply voltage.

by JACK DARR
SERVICE EDITOR

THE WORD "VARIAC" IS A REGISTERED trademark of the General Radio Co., which makes a lot of very high quality instruments. ("Vary-ac", so it means just what it says.). This is a variable voltage-output transformer, usually made like a toroid, with a slider around the top, to select the desired output voltage. Most of them are actually autotransformers with a sliding tap. Most of us say Variac when we mean any variable-voltage transformer, but GR might not like it, so I'd better use VVT, since there are quite a few different makes available now.

At any rate, this thing can be one of the most versatile, and useful, pieces of test equipment in any electronics service shop. In fact, it could be called invaluable for men working with solid-state equipment. Let's look at a few of the things it can do.

Here's one that comes in regularly in the Service Clinic mailbag: "I've just replaced all four big power transistors in this amplifier, and I'm afraid to turn it on!" That's a condensed version, of course, but you know—you've been there. So have I. Here's an easy way to avoid a heavy financial loss and some grey hairs, in cases like this.

Open the collector power supply circuit, or the main dc supply circuit, and hook in a suitable dc ammeter. Now, plug the thing into the VVT. Set this to zero volts and turn the equipment switch on. Now, start bringing the ac voltage up a little at a time, watching that ammeter like a hawk. Let's say that the normal resting current (no signal) on this amplifier is 1.0 A.

When you get the line voltage up to around 50 volts, you see that you're already drawing 1.3 A!

This is the time to "Back off!" Stop right there and investigate. You have *still* got a problem! With symptoms like this, the most likely thing would be a bad bias diode, emitter resistor, or shorted driver transistor (in the common direct-coupled circuits) Something is playing heck with the *bias* on those four big (new!) output transistors. Since they're taking more rest current than they should, with the supply voltage only half normal, the chances are that they *would* blow out if you slapped the full line voltage on them without checking!

By reducing the input voltage, you reduce the dc supply voltage in direct proportion, in sets with solid-state rectifiers. Even with tube rectifiers, this method will still work. You can hold the *power* dissipation in output stages, or any high-power stage, down to a safe level without resorting to the famous "smoke test".

In solid-state circuits, you can read the bias voltages, collector voltages, etc, and get an idea of what they would do at normal voltage. In other words, if the supply is half normal, the bias ought to be about the same percentage, and so on. The most important thing is the *current* drain, since this is the main figure in the I^2R power formula.

You'll be surprised; a great bulk of this type of equipment will *work* very well at

(continued on page 61)

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. If return postage is not included, we cannot process your question. Write: Service Editor, Radio-Electronics, 200 Park Ave. South, New York 10003.

R-E's Substitution guide for replacement transistors

PART XV

compiled by

ROBERT & ELIZABETH SCOTT

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

DM—D. M. Semiconductor Co., P.O. Box 131, Melrose, Mass. 02176

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

ICC—International Components, 10 Daniel Street, Farmingdale, N.Y. 11735

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

WOR—Workman Electronic Products, Inc., Box 3828, Sarasota, Fla. 33578

ZEN—Zenith Sales Co., 5600 W. Jarvis Ave., Chicago, Ill. 60648

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. The first part of this Guide appeared in March 1973.

	ARCH	DM	G-E	ICC	IR	MAL	MOT	RCA	SPR	SYL	WOR	ZEN
2N3170	NA	TS-5005	NA	ICC-S5005	NA	NA	HEP-S5005	NA	NA	NA	WEP WS5005	NA
2N3171	NA	T-248	GE-74	ICC-248	TR-29	NA	HEP-248	NA	NA	NA	NA	NA
2N3172	NA	T-248	GE-74	ICC-248	TR-29	NA	HEP-248	NA	NA	NA	NA	NA
2N3173	NA	TS-5006	GE-74	ICC-S5006	NA	NA	HEP-S5006	NA	NA	NA	WEP WS5007	NA
2N3174	NA	TS-5005	GE-74	ICC-S5005	NA	NA	HEP-S5005	NA	NA	NA	WEP WS5005	NA
2N3175	NA	TS-5008	NA	ICC-S5008	NA	NA	HEP-S5008	NA	NA	NA	WEP WS5005	NA
2N3176	NA	TS-5002	NA	ICC-S5002	NA	NA	HEP-S5002	NA	NA	NA	WEP WS5005	NA
2N3177	NA	TS-5005	NA	ICC-S5005	NA	NA	HEP-S5005	NA	NA	NA	WEP WS5005	NA
2N3178	NA	TS-5005	NA	ICC-S5005	NA	NA	HEP-S5005	NA	NA	NA	WEP WS5005	NA
2N3179	NA	TS-5008	NA	ICC-S5008	NA	NA	HEP-S5008	NA	NA	NA	WEP WS5005	NA
2N3180	NA	TS-5002	NA	ICC-S5002	NA	NA	HEP-S5002	NA	NA	NA	WEP WS5005	NA
2N3181	NA	TS-5005	NA	ICC-S5005	NA	NA	HEP-S5005	NA	NA	NA	WEP WS5005	NA
2N3182	NA	TS-5005	NA	ICC-S5005	NA	NA	HEP-S5005	NA	NA	NA	WEP WS5005	NA
2N3183	NA	T-248	GE-74	ICC-248	TR-29	NA	HEP-248	NA	NA	NA	NA	NA
2N3184	NA	T-248	GE-74	ICC-248	TR-29	NA	HEP-248	NA	NA	NA	NA	NA
2N3185	NA	TS-5001	GE-74	ICC-S5005	NA	NA	HEP-S5005	NA	NA	NA	WEP WS5005	NA
2N3186	NA	TS-5005	GE-74	ICC-S5005	NA	NA	HEP-S5005	NA	NA	NA	WEP WS5005	NA
2N3187	NA	TS-5008	NA	ICC-S5008	NA	NA	HEP-S5008	NA	NA	NA	WEP WS5005	NA
2N3188	NA	TS-5002	NA	ICC-S5002	NA	NA	HEP-S5002	NA	NA	NA	WEP WS5005	NA
2N3189	NA	TS-5005	NA	ICC-S5005	NA	NA	HEP-S5005	NA	NA	NA	WEP WS5005	NA
2N3190	NA	TS-5005	NA	ICC-S5005	NA	NA	HEP-S5005	NA	NA	NA	WEP WS5005	NA
2N3191	NA	TS-5008	NA	ICC-S5008	NA	NA	HEP-S5008	NA	NA	NA	WEP WS5005	NA
2N3192	NA	TS-5002	NA	ICC-S5002	NA	NA	HEP-S5002	NA	NA	NA	WEP WS5005	NA
2N3193	NA	TS-5005	NA	ICC-S5005	NA	NA	HEP-S5005	NA	NA	NA	WEP WS5005	NA
2N3194	NA	TS-5005	NA	ICC-S5005	NA	NA	HEP-S5005	NA	NA	NA	WEP WS5005	NA
2N3195	NA	T-248	GE-74	ICC-248	TR-29	NA	HEP-248	NA	NA	NA	NA	NA
2N3196	NA	T-248	GE-74	ICC-248	TR-29	NA	HEP-248	NA	NA	NA	NA	NA
2N3197	NA	TS-5005	GE-74	ICC-S5005	NA	NA	HEP-S5005	NA	NA	NA	WEP WS5005	NA
2N3198	NA	TS-5005	GE-74	ICC-S5005	NA	NA	HEP-S5005	NA	NA	NA	WEP WS5005	NA
2N3199	NA	T-700	GE-69	ICC-700	NA	PTC 124	HEP-700	NA	NA	NA	WEP WS5007	NA
2N3200	NA	TS-5007	GE-69	ICC-S5007	NA	NA	HEP-S5007	NA	NA	NA	WEP WS5007	ZEN 211
2N3201	NA	TS-5006	NA	ICC-S5006	NA	NA	HEP-S5006	NA	NA	NA	WEP WS5007	NA
2N3202	RS276-2025	T-242	NA	ICC-242	NA	PTC 111	HEP-242	SK-3025	RT-115	ECG 129	WEP 242	NA
2N3203	RS276-2025	T-242	NA	ICC-242	NA	PTC 111	HEP-242	SK 3025	RT-115	ECG 129	WEP 242	NA
2N3204	NA	TS-3003	NA	ICC-S3003	NA	PTC 111	HEP-S3003	NA	NA	NA	NA	NA
2N3205	NA	TS-3031	GE-69	NA	NA	NA	HEP-S5007	NA	NA	NA	NA	NA
2N3206	NA	TS-3031	GE-69	NA	NA	NA	HEP-S5007	NA	NA	NA	NA	NA
2N3207	NA	NA	NA	NA	NA	NA	HEP-S5006	NA	NA	NA	NA	NA
2N3208	RS276-2025	T-242	NA	ICC-242	NA	PTC 111	HEP-242	SK 3025	RT-115	ECG 129	WEP 242	NA
2N3209	NA	T-52	GE-21	ICC-52	TR-20	NA	HEP-52	SK 3118	RT-126	ECG 106	WEP 52	NA
2N3210	RS276-2009	T-53	GE-20	ICC-53	IRTR-64	PTC 136	HEP-53	SK 3122	RT-102	ECG 123A	WEP 735	ZEN 102
2N3211	RS276-2009	T-53	GE-20	ICC-53	NA	PTC 136	HEP-53	SK 3122	RT-102	ECG 123A	WEP 735	ZEN 102
2N3212	NA	T-235	GE-25	NA	TR-01	PTC 105	NA	SK 3009	RT-127	ECG 121	WEP 232	NA
2N3213	NA	T-232	GE-16	NA	TR-01	PTC 105	NA	SK 3009	RT-127	ECG 121	WEP 232	NA
2N3214	NA	T-232	GE-16	NA	TR-01	PTC 105	NA	SK 3009	RT-127	ECG 121	WEP 232	NA
2N3215	NA	T-232	GE-16	NA	TR-01	PTC 105	NA	SK 3009	RT-127	ECG 121	WEP 232	NA
2N3216	NA	T-2	GE-1	ICC-2	IRTR-84	PTC 109	HEP-2	NA	NA	ECG 160	WEP 637	ZEN 300
2N3217	RS276-2023	T-52	GE-22	ICC-52	TR-20	PTC 103	HEP-52	SK 3114	RT-115	ECG 159	WEP 717	NA
2N3218	RS276-2023	T-52	GE-22	ICC-52	TR-20	PTC 103	HEP-52	SK 3114	RT-115	ECG 159	WEP 717	NA
2N3219	RS276-2023	T-52	GE-21	ICC-52	TR-27	PTC 103	HEP-52	SK 3114	RT-115	ECG 159	WEP 717	NA
2N3224	NA	TS-3031	GE-21	ICC-S3031	NA	PTC 127	HEP-S3031	NA	NA	NA	WEP WS3031	NA
2N3225	NA	TS-3031	NA	ICC-S3031	NA	PTC 127	HEP-S3031	NA	NA	NA	WEP WS3031	NA
2N3226	NA	T-247	NA	ICC-247	TR-26	PTC 119	HEP-247	NA	RT-131	ECG 130	WEP 247	NA
2N3227	RS276-2011	T-56	NA	ICC-56	TR-21	PTC 133	HEP-56	SK 3039	RT-113	ECG 108	WEP 56	ZEN 104
2N3228	NA	SR-1221	GEMR-4	ICC-R1221	IR-1776	NA	HEP-R1221	SK 3502	NA	ECG 122	NA	NA
2N3229	NA	TS-3020	GE-66	NA	NA	NA	NA	NA	NA	NA	NA	NA
2N3232	NA	T-247	NA	ICC-247	IRTR-59	PTC 118	HEP-247	NA	RT-131	ECG 130	WEP-247	NA
2N3233	NA	TS-5004	GE-75	ICC-S5004	TR-36	PTC 118	HEP-S5004	NA	NA	ECG 130	WEP-247	NA
2N3234	NA	T-707	NA	ICC-707	IRTR-61	PTC 118	HEP-707	NA	NA	NA	WEP-707	ZEN 204
2N3235	NA	T-704	NA	ICC-704	TR-36	PTC 140	HEP-704	NA	NA	NA	WEP-247	NA
2N3236	NA	T-704	GE-75	ICC-704	TR-36	PTC 140	HEP-704	NA	NA	NA	WEP-247	NA
2N3237	NA	TS-7000	GE-75	ICC-S7000	TR-36	NA	HEP-S7000	NA	NA	NA	WEP-7000	NA
2N3238	NA	T-704	GE-75	ICC-704	TR-36	PTC 140	HEP-704	NA	NA	NA	WEP-247	NA
2N3239	NA	T-704	GE-75	ICC-704	TR-36	PTC 140	HEP-704	NA	NA	NA	WEP-247	NA
2N3241	RS276-2009	T-53	GE-20	ICC-53	NA	PTC 121	HEP-53	SK 3124	RT-102	ECG 123A	WEP-735	ZEN 102
2N3242	RS276-2009	T-50	GE-20	ICC-50	NA	PTC 121	HEP-50	SK 3124	RT-102	ECG 123A	WEP-735	ZEN 100
2N3244	NA	TS-3027	GE-67	ICC-S3027	IRTR-65	NA	HEP-S3027	NA	NA	NA	WEP-S3027	NA
2N3245	NA	TS-3031	GE-67	ICC-S3031	TR-65	PTC 131	HEP-S3031	SK 3118	RT-126	ECG 106	WEP-52	NA
2N3246	RS276-2009	T-50	GE-62	ICC-50	NA	PTC 121	HEP-50	SK 3124	RT-102	ECG 123A	WEP-735	ZEN 100
2N3247	RS276-2009	T-53	GE-20	ICC-53	NA	PTC 133	HEP-53	SK 3124	RT-102	ECG 123A	WEP-735	ZEN 102
2N3248	RS276-2009	T-52	GE-22	ICC-52	NA	PTC 103	HEP-52	SK 3114	RT-115	ECG 159	WEP-717	NA
2N3249	RS276-2009	T-52	GE-21	ICC-52	NA	PTC 103	HEP-52	SK-3114	RT-115	ECG 159	WEP-717	NA
2N3250	RS276-2009	T-52	GE-21	ICC-52	TR-20	PTC 103	HEP-52	SK 3114	RT-115	ECG 159	WEP-717	NA
2N3251	RS276-2009	T-52	GE-21	ICC-52	NA	PTC 103	HEP-52	SK 3114	RT-115	ECG-159	WEP-717	NA
2N3252	NA	TS-3001	GE-63	ICC-S3001	IRTR-25	NA	HEP-S3001	NA	NA	NA	NA	NA

NA=NOT AVAILABLE

(turn page)

	ARCH	DM	G-E	ICC	IR	MAL	MOT	RCA	SPR	SYL	WOR	ZEN
2N3253	NA	TS-3001	GE-28	ICC-S3001	NA	NA	HEP-S3001	NA	NA	NA	NA	NA
2N3257	NA	SR-1001	NA	ICC-R1001	NA	NA	HEP-R1001	NA	NA	NA	NA	NA
2N3258	NA	SR-1001	NA	ICC-R1001	NA	NA	HEP-R1001	NA	NA	NA	NA	NA
2N3259	NA	SR-1002	NA	ICC-R1002	NA	NA	HEP-R1002	NA	NA	ECG 5401	NA	NA
2N3261	RS276-2009	T-53	GE-20	ICC-53	IRTR-64	PTC 136	HEP-53	SK 3122	RT-102	ECG 123A	WEP-735	ZEN 102
2N3262	NA	T-714	NA	ICC-714	IRTR-65	PTC 144	HEP-714	SK 3024	NA	ECG 128	WEP-243	NA
2N3267	RS276-2003	T-3	GE-9	ICC-3	TR-17	PTC 107	HEP-3	NA	NA	ECG 160	WEP-637	ZEN 301
2N3268	RS276-2009	T-53	GE-27	ICC-53	NA	PTC 144	HEP-53	SK 3124	RT-100	ECG 123	WEP-53	ZEN 302
2N3277	NA	T-803	NA	ICC-803	NA	NA	HEP-803	NA	NA	NA	NA	NA
2N3278	NA	T-803	NA	ICC-803	NA	NA	HEP-803	NA	NA	NA	NA	NA
2N3279	RS276-2003	T-3	GE-51	ICC-3	TR-17	PTC 107	HEP-3	NA	NA	ECG 160	WEP-637	ZEN 301
2N3280	RS276-2003	T-3	GE-51	ICC-3	TR-17	PTC 107	HEP-3	NA	NA	ECG 160	WEP-637	ZEN 301
2N3281	RS276-2003	T-3	GE-51	ICC-3	TR-17	PTC 107	HEP-3	NA	NA	ECG 160	WEP-637	ZEN 301
2N3282	RS276-2003	T-3	GE-51	ICC-3	TR-17	PTC 107	HEP-3	NA	NA	ECG 160	WEP-637	ZEN 301
2N3283	RS276-2003	T-3	GE-50	ICC-3	TR-17	PTC 107	HEP-3	NA	NA	ECG 160	WEP-637	ZEN 301
2N3284	RS276-2003	T-3	GE-50	ICC-3	TR-17	PTC 107	HEP-3	NA	NA	ECG 160	WEP-637	ZEN 301
2N3285	RS276-2003	T-3	GE-50	ICC-3	TR-17	PTC 107	HEP-3	NA	NA	ECG 160	WEP-637	ZEN 301
2N3286	RS276-2003	T-3	GE-50	ICC-3	TR-17	PTC 107	HEP-3	NA	NA	ECG 160	WEP-637	ZEN 301
2N3287	RS276-2011	T-56	GE-61	ICC-56	IRTR-80	PTC 121	HEP-56	SK 3018	RT-113	ECG 161	WEP-719	ZEN 104
2N3288	RS276-2011	T-56	GE-61	ICC-56	IRTR-80	PTC 121	HEP-56	SK 3018	RT-113	ECG 161	WEP-719	ZEN 104
2N3289	RS276-2011	T-56	GE-61	ICC-56	IRTR-80	PTC 121	HEP-56	SK 3019	RT-113	ECG 161	WEP-719	ZEN 104
2N3290	RS276-2011	T-56	GE-61	ICC-56	IRTR-80	PTC 121	HEP-56	SK 3019	RT-113	ECG 161	WEP-719	ZEN 104
2N3291	RS276-2011	T-56	GE-61	ICC-56	IRTR-80	PTC 115	HEP-56	SK 3019	RT-113	ECG 161	WEP-719	ZEN 104
2N3292	RS276-2011	T-56	GE-61	ICC-56	IRTR-80	PTC 115	HEP-56	SK 3019	RT-113	ECG 161	WEP-719	ZEN 104
2N3293	RS276-2011	T-56	GE-61	ICC-56	IRTR-80	PTC 115	HEP-56	SK 3019	RT-113	ECG 161	WEP-719	ZEN 104
2N3294	RS276-2011	T-56	GE-61	ICC-56	IRTR-80	PTC 115	HEP-56	SK 3019	RT-113	ECG 161	WEP 719	ZEN 104
2N3295	NA	TS-3008	GE-63	ICC-S3008	TR-25	NA	HEP-S3008	NA	NA	NA	NA	NA
2N3296	NA	TS-3020	GE-28	NA	IRTR-66	PTC 110	NA	NA	NA	NA	NA	NA
2N3297	NA	T-247	GE-19	NA	NA	PTC 119	NA	NA	NA	NA	NA	NA
2N3298	NA	T-713	GE-10	ICC-713	NA	PTC 121	HEP-713	NA	NA	NA	WEP-712	NA
2N3299	NA	TS-3008	GE-18	ICC-S3008	NA	PTC 125	HEP-S3008	NA	NA	NA	NA	NA
2N3300	NA	TS-3008	NA	ICC-S3008	IRTR-63	NA	HEP-S3008	NA	NA	NA	NA	NA
2N3301	RS276-2009	T-736	GE-20	ICC-736	TR-21	PTC 136	HEP-736	SK 3122	RT-102	ECG 123A	WEP-735	ZEN 120
2N3302	RS276-2009	T-736	GE-20	ICC-736	TR-21	PTC 136	HEP-736	SK 3122	RT-102	ECG 123A	WEP-735	ZEN 120
2N3303	NA	TS-3001	NA	ICC-S3001	NA	NA	HEP-S3001	NA	NA	NA	NA	NA
2N3304	NA	T-51	GE-21	NA	NA	PTC 131	NA	NA	RT-126	ECG 106	WEP-52	NA
2N3305	RS276-2021	T-51	GE-21	ICC-51	TR-19	PTC 127	HEP-51	SK 3114	RT-115	ECG 159	WEP-717	ZEN 101
2N3306	RS276-2021	T-51	GE-21	ICC-51	TR-19	PTC 127	HEP-51	SK 3114	RT-115	ECG 109	WEP-717	ZEN 101
2N3307	RS276-2023	T-52	GE-21	ICC-52	IRTR-52	PTC 103	HEP-52	SK 3118	RT-115	ECG 109	WEP-717	NA
2N3308	RS276-2023	T-52	GE-21	ICC-52	IRTR-52	PTC 103	HEP-52	SK 3118	RT-115	ECG 159	WEP-717	NA
2N3310	RS276-2009	T-53	GE-18	ICC-53	NA	PTC 123	HEP-53	NA	RT-100	ECG 123	WEP-53	ZEN 102
2N3311	NA	T-231	GE-4	ICC-231	NA	PTC 106	HEP-231	SK 3012	NA	ECG 105	WEP-233	NA
2N3312	NA	T-231/233	GE-4	ICC-231/233	NA	PTC 106	HEP-231/233	SK 3012	NA	ECG 105	WEP-233	ZEN 327
2N3313	NA	T-233	GE-4	ICC-233	NA	PTC 106	HEP-233	SK 3012	NA	ECG 105	WEP-233	ZEN 327
2N3314	NA	T-231	GE-4	ICC-231	NA	PTC 106	HEP-231	SK 3012	NA	ECG 105	WEP-233	NA
2N3315	NA	T-231/233	GE-4	ICC-231/233	NA	PTC 106	HEP-231/233	NA	NA	ECG 105	WEP-233	ZEN 327
2N3316	NA	T-233	NA	ICC-233	NA	PTC 106	HEP-233	NA	NA	NA	WEP-233	ZEN 327
2N3317	RS276-2023	T-52	GE-21	ICC-52	TR-30	PTC 131	HEP-52	SK 3114	RT-115	ECG 159	WEP-717	NA
2N3318	RS276-2023	T-52	GE-22	ICC-52	NA	PTC 131	HEP-52	SK 3114	RT-115	ECG 159	WEP-717	NA
2N3319	RS276-2023	T-52	GE-22	ICC-52	NA	PTC 131	HEP-52	SK 3114	RT-115	ECG 159	WEP-717	NA
2N3320	RS276-2003	T-3	GE-51	ICC-3	TR-17	PTC 107	HEP-3	NA	NA	ECG 160	WEP-637	ZEN 301
2N3321	RS276-2003	T-3	GE-51	ICC-3	NA	PTC 107	HEP-3	NA	NA	ECG 160	WEP-637	ZEN 301
2N3322	RS276-2003	T-3	GE-51	ICC-3	NA	PTC 107	HEP-3	NA	NA	ECG 160	WEP-637	ZEN 301
2N3323	RS276-2003	T-3	GE-50	ICC-3	IRTR-85	PTC 109	HEP-3	NA	NA	ECG 160	WEP-637	ZEN 301
2N3324	RS276-2005	T-636	GE-51	ICC-636	IRTR-85	PTC 109	HEP-636	NA	NA	ECG 160	WEP-637	ZEN 312
2N3325	RS276-2003	T-3	GE-51	ICC-3	IRTR-85	PTC 109	HEP-3	NA	NA	ECG 160	WEP-637	ZEN 301
2N3326	NA	TS-3001	NA	ICC-S3001	IRTR-64	NA	HEP-S3001	NA	NA	NA	NA	NA
2N3328	NA	T-803	GE-50	ICC-803	NA	NA	HEP-803	NA	NA	NA	NA	NA
2N3329	NA	T-803	NA	ICC-803	NA	NA	HEP-803	NA	NA	NA	NA	NA
2N3330	NA	T-803	NA	ICC-803	NA	NA	HEP-803	NA	NA	NA	NA	NA
2N3331	NA	T-803	NA	ICC-803	NA	NA	HEP-803	NA	NA	NA	NA	NA
2N3332	NA	T-803	NA	ICC-803	NA	NA	HEP-803	NA	NA	NA	NA	NA
2N3333*	NA	NA	NA	ICC-F1035	NA	NA	HEP-F1035	NA	NA	NA	NA	NA
2N3334*	NA	NA	NA	ICC-F1035	NA	NA	HEP-F1035	NA	NA	NA	NA	NA
2N3335*	NA	NA	NA	ICC-F1035	NA	NA	HEP-F1035	NA	NA	NA	NA	NA
2N3336*	NA	NA	NA	ICC-F1035	NA	NA	HEP-F1035	NA	NA	NA	NA	NA
2N3337	NA	TS-0004	GE-61	ICC-S0004	NA	PTC 121	HEP-S0004	NA	NA	NA	NA	ZEN 127
2N3338	NA	TS-0004	GE-61	ICC-S0004	TR-24	PTC 121	HEP-S0004	SK 3117	RT-113	ECG 161	WEP-719	ZEN 127
2N3339	NA	TS-0004	GE-61	ICC-S0004	TR-24	PTC 121	HEP-S0004	SK 3117	RT-113	ECG 161	WEP-719	ZEN 127
2N3340	RS276-2009	T-50	GE-20	ICC-50	NA	PTC 121	HEP-50	SK 3122	RT-102	ECG 123A	WEP-735	ZEN 100

*Indicates a dual transistor for high-speed switching, diff amplifier etc. Likely to be a matched pair. Use two of the type specified, matching when necessary, on a curve tracer or lab-type transistor checker.

NA=NOT AVAILABLE

(continued next month)

(continued from page 58)

greatly reduced supply voltages. Work well enough, that is, to make many useful tests; even distortion, and that sort of thing. If it's clipping at these reduced voltages, it'll be worse at full supply voltage.

What if the equipment is dc powered? 12-volts automotive, 28-volt aircraft radio, etc? Same thing. The only difference is that now, you connect the bench dc power supply to the unit, and then plug the power supply into the VVT. This will make an ordinary dc power supply into a very handy, continuously-variable dc voltage supply. Even a stock battery-charger, with a filter capacitor across the output, becomes a useful dc source for anything from little 9-volt transistor radios on up.

You can start at zero and bring the dc voltage output up to maximum very smoothly. For cases where you want to check at higher than standard voltages, crank the VVT up to 140 volts line, and your 12-volt supply will go to 14 volts and more. This is the exact voltage you want to check things, such as simulating actual operating conditions in a car with the engine running at cruising speed.

TV sets? Same thing. You've just replaced the horizontal output transistor, or some other high-power device. Can you turn it on without wincing? Yep. Plug it into the VVT, start at zero volts, with the current meter in the circuit, and sneak up on it. Here again, you'll be surprised at how well the thing works with far less than the normal ac line voltage. I've seen quite a few solid-state TV sets that would make good pictures, with ample width and brightness, at line voltages as low as 90 volts.

Still in the TV department, this thing is ideal for those weird complaints of loss of width, brightness, etc, at the home, although the blasted thing will sit on your bench and play perfectly. Plug it into the VVT, and run the line voltage down a little. See how far down you have to go before you see a loss of width, or whatever it was. This will give you some idea of the condition of things. For a rough rule-of-thumb, the average set should go down to at least 100 volts input before you lose too much width, etc. (Ratings on the label are 105-120 volts.) If it'll do this, the set is probably OK and you could have an intermittent drop in the line voltage at the home.

Another handy use: checking for intermittents in the same class; "Won't play for more than half an hour at home. Plays all day on the bench!" Plug it into the VVT, crank the line voltage up to about 125 or 135 volts, and let it play for about an hour. This will help show up obscure troubles, such as transistor leakage due to excessive collector voltage, heating, and so on. To the best of my knowledge, this will *not* damage a properly-designed set in good working order. At least, I've used this test on a lot of sets, and never blown up a good one yet. (I've tried, too.)

You'll find dc voltage regulator circuits in a lot of things lately. The VVT is ideal (essential is a better word) for checking these. You will even find voltage regulators in a lot of units used on battery power, such as cartape players, etc. By using the tests given just now, both for ac-powered units and

dc-powered things, you can run the input voltage up and down at will, while monitoring the voltage-regulator output.

This is very important, in a lot of, 'em. For example, the old GE TA, TB, etc chasses had a 12-volt regulator. Let this get out of whack, and you had all kinds of problems. Test procedures for these are given in great detail in the service data, and the VVT makes these not only possible but very easy.

These things aren't expensive. Prices start at about $15.00 for a medium-sized unit, say around the 150 to 200 watt rating. For maximum usefulness, get one rated up around 250 to 300 watts, so that you can work with the larger color TV sets. I started out with a small one, and wound up with a bigger one, which cost only a little bit more. Be sure to get the type with a 120-volt input, and *140-volt* output, so that you can *raise* the line voltage above normal when you need to. Several of them are rated 120 volts in, 120 volts out, so that you can't get *above* the line voltage. Cost is practically the same.

The arithmetic of this is simple, even for me. Say $20.00 for a good VVT. Two big power transistors cost from $25.00 on up to $40.00! If you catch an unsuspected fault, and save even one pair of output transistors, your VVT just became a "free one!" It paid for itself on one job. Get the picture? **R-E**

reader questions

DC SUPPLY FOR HOME USE

A lot of my customers want a 12-volt dc power supply so that they can play auto-type tape players, etc. in their homes. Do you have a schematic for a good one?—R.G., Cherry Hill, Ariz.

Don't need a schematic. Go to your nearest auto-supply store, etc. Get 3 to 4 amp trickle type battery charger. Go to your radio-TV supply house. Get a 2000-μF 25-volt electrolytic.

Connect capacitor across output of battery charger, watching polarity. Job over.

PARALLEL DIODES FOR HEAVY LOAD

Question. I have an RCA CTC-40, with a shorted horizontal trace diode. Ordered replacement, but got a Part No. 131475. This is rated at 6.5 amps. Original was a No. 126857. The high-voltage came back, all voltages checked normal, picture fine. The diode got very hot.

Checking current, I read about 10 amps through it! Rechecked everything else. OK. Ordered another diode, and got 131475 again. So, just for luck, I hooked both of them in parallel, crossed my fingers, and sent the set back.

It's been more than a week now, and I haven't heard anything. What would you have done?—E. S., Corydon Ind.

The same thing!

IC I.F. WITH PROBLEMS

This Pioneer SX-1500T Stereo receiver has a couple of problems. No MPX, and the receiver cuts out when the "mute" switch is turned on. I can't find a schematic Any ideas?—W.G., Madison. Al.

No original ones. So I wrote to the company, and a nice man promptly sent me the service data, plus a suggestion that this was probably a bad μA-703 IC. They use four of them in the i.f. strip. He suggested other sources for the μA-703's. Sylvania makes a replacement, their ECG-703A, and there are others. (Look in the ads in the back pages! You'll find them there, too.)

BATTERY CHARGER: CURRENT RATING?

I built this battery charger from a kit. It uses a Triad F41X transformer, an SCR, etc. It will start out, on a low battery, at 3 to 4 amps, then drop to about 2 amps. I'd like to get more current. How?—A.F., Davidson, N.C.

The reaction you're getting is normal, with these small battery chargers. They'll start high then drop off as the battery builds up.

The only way you could get a higher current would be to change power transformers. The Triad F41X is rated at 12 volts each side of CT, and *2.0 amps*. You're overloading it at 3 to 4 amps but it will take it. You could find a unit with a 5 to 6 amp rating, and slightly higher voltage, if you want a faster charge.

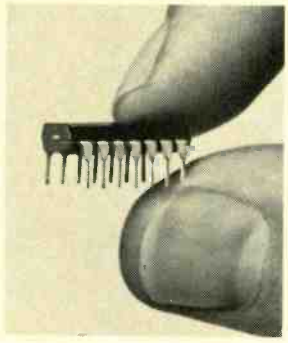
HORIZONTAL STABILIZER COIL WON'T WORK.

This GE M110YBG has a peculiar problem. Horizontal sync won't hold. The horizontal oscillator coil doesn't have any effect at all, no matter where I turn the slug. Any suggestions?—L.A., Hobe Sound Fla.

Yes sir! One of them would be a careful check of that horizontal stabilizer coil. This very definitely *should* have some effect on the frequency. The coil may be shorted, or the .0022-μF capacitor may be open. One other good possibility: take the core all the way out of that coil and check it. I have found a few of these with half of the core broken off and missing. This throws the coil so far off resonance that it has no effect.

THREE-INCH PICTURE TUBE? OY, VEH!

Can you tell me where to get a 3-inch picture tube for a Symphonic TPS-5050 TV? Part No. C6407. I hear the company is out of business.—Chris Johnson, 12122 Rip Van Winkle, Houston, Tex. 77024.



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Already, as a result, a two-way radio can now be fitted inside a signet ring. A complete hearing aid can be worn entirely inside the ear. There is a new computer/calculator that weighs only nine ounces, fits easily into a shirt pocket, yet in a split second performs logorithmic, trigonometric and mathematical functions with a single keystroke and 10-digit accuracy. And new, extremely accurate watches consisting only of a quartz crystal, LSI circuits and a solid-state time display take only minutes to assemble.

And this is only the beginning.

Soon kitchen computers may keep the housewife's

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Money may become obsolete. Instead you will simply carry an electronic charge account card. Your employer will credit your account after each week's work and merchants will charge each of your purchases against it.

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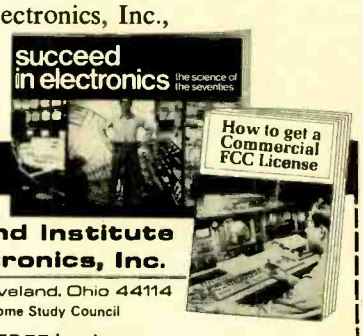

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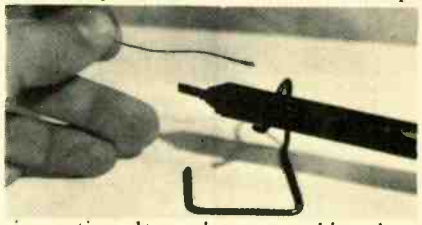
RE-30

Circle 74 on reader service card

WIRE-STRIPPING COMPOUND

If you use Strip-X (a liquid chemical from G-C for stripping enamel insulation from wires) frequently, it will eventually discolor and slow its stripping action. It can be restored by placing the Strip-X coated wire over the heat of a soldering iron, as shown.



—*A.E. Playcan*

next month

JUNE 1974

- **The Videodiscs Are Coming**
  Here's an up-to-the-minute report on how soon we will see them, how they work, and how much they will cost.

- **Build A Guitar Preamp**
  This unusual electronic device provides features not found in the usual guitar preamplifier.

- **Understanding MOS Character Generators**
  These are the devices that make letters and numbers appear on TV screens. Don Lancaster tells how these rather special IC's work.

- **CD-4 Demodulator—The Second Generation**
  Len Feldman shows how CD-4 record systems have grown up. New circuits produce even better discrete 4-channel performance.

- **Build Sine Converter For Electronic Music**
  Another add-on module for your growing electronic music system.

PLUS:
Step-By-Step TV Troubleshooting
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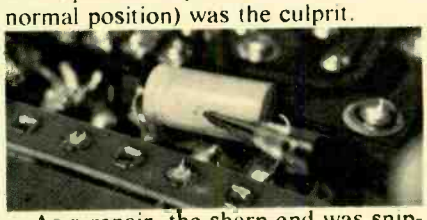
Circle 77 on reader service card

MECHANICAL-FAILURE SHORT CIRCUITS

What do you do when resistance measurements indicate a ground or short circuit and the schematic diagram doesn't even give a hint of such a possibility?

One thing to be sure to do is check carefully *around and under* any component (like those miniature electrolytic coupling capacitors) insulated with plastic film or heat-shrink tubing.

In the photograph the pencil point indicates a pinhole puncture in the plastic covering of a coupling capacitor. A sharp end of a wire lead protruding from the terminal strip (hidden when the capacitor is pressed down into its normal position) was the culprit.



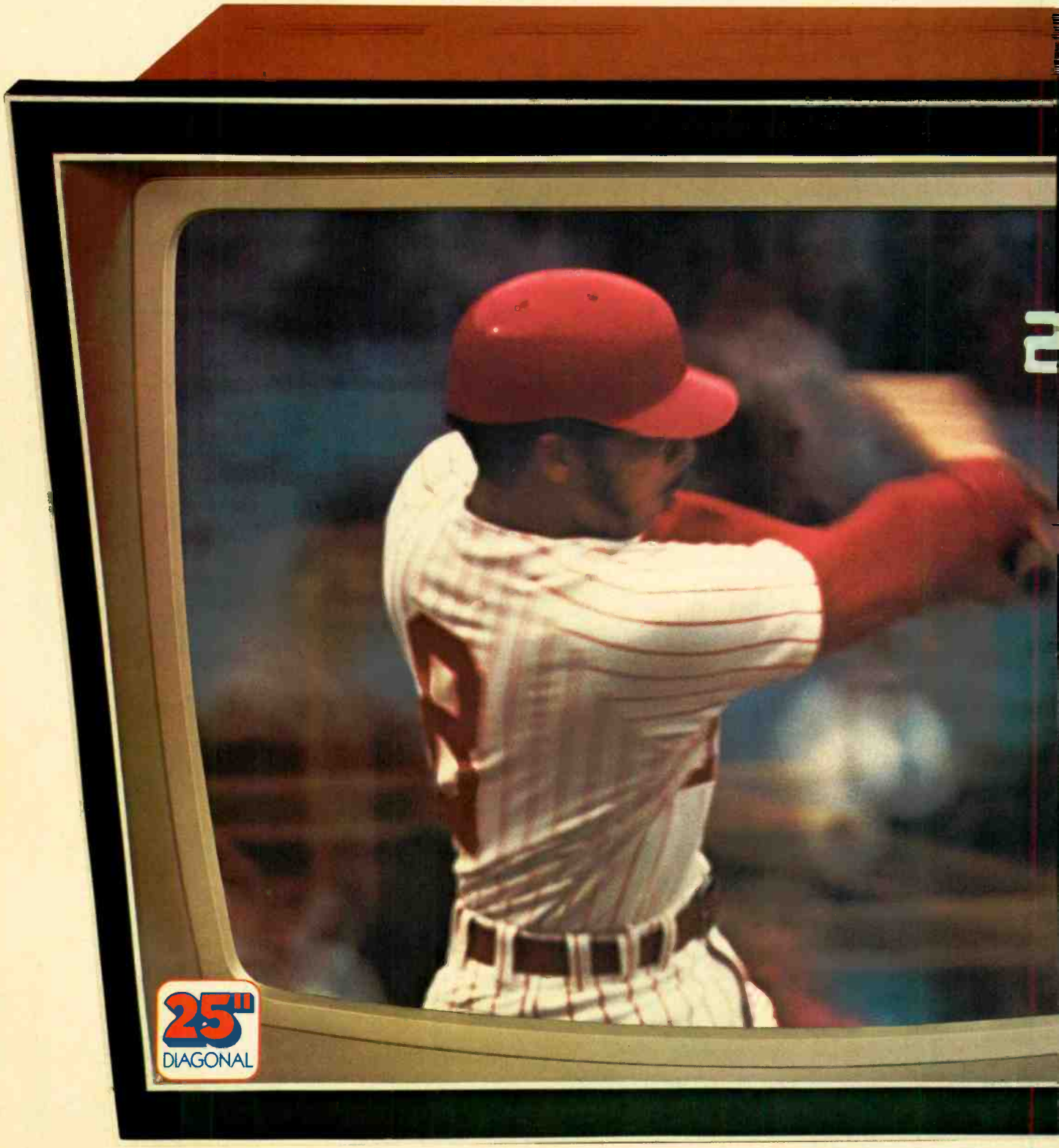
As a repair, the sharp end was snipped off and several layers of plastic tape were applied, over the hole in the insulation, on the under side of the capacitor.

When adding insulation to a component be sure not to cover any markings of capacitance or working voltage with the tape.—*Elmer C. Carlson*

It's new! It's digital!

Build it

Bell & Howell Schools introduces a new learn-at-home program in electronics that includes building a giant-screen color TV with these digital features:



yourself!

Digital clock
that flashes on screen

Channel numbers
that flash on the screen

Automatic pre-set
channel selector

Simulated TV picture

Have fun doing it!

What a thrill to have an at-home educational program in which you actually build your own color TV! Especially a TV with features made possible by the new applications of digital electronics!

Like channel numbers that flash right on the screen! No more squinting to see which channel you're on or want to turn to.

An on-screen digital clock! Just a push of a button and your TV tells you the time of day!

An automatic channel selector that you preset to skip over "dead" channels and go directly to the channels of your choice.

Plus . . . silent, all-electronic tuning, *state-of-the-art* integrated circuitry, Black Matrix picture tube and 100% solid-state chassis for a bright, sharp picture with long life and dependability.

You learn valuable skills in electronics through experiments and testing as you build this advanced-design color TV.

Do it for your future!

Once you complete this new learn-at-home program from Bell & Howell Schools, you'll have the specialized skills to service color TV's plus the knowledge that you can apply to repair a variety of home electronic equipment. No better or more practical at-home training in electronics is available anywhere!

These skills could open up new income opportunities for you, full or part time. While many of our students do not ask for employment assistance, it is available. Of course, no assurance of income opportunities can be offered.

Do it now!

Find out how you can build and keep this Bell & Howell 25-inch diagonal color TV with digital features—plus our exclusive Electro-Lab® electronics training system with digital multimeter, solid-state "triggered sweep" oscilloscope and design console.

Find out, too, about the Lab Starter Kit that gives you "hands on" experience with your first lesson—and about our toll-free phone-in assistance and in-person "help sessions" to assist you every step of the way.

Mail postage-free card today!

This Bell & Howell Schools program is approved by the state approval agency for Veterans' Benefits. Please check the appropriate box on the card for free information.

If card has been removed, write:

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4141 Belmont, Chicago, Illinois 60641

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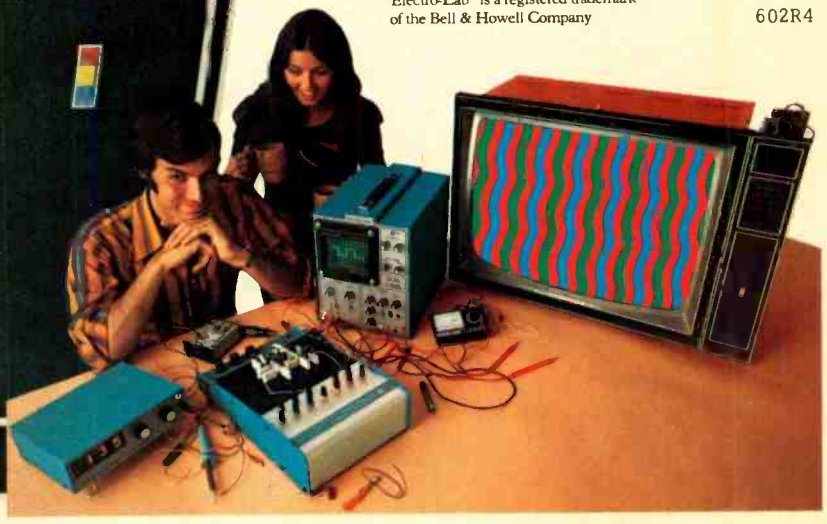
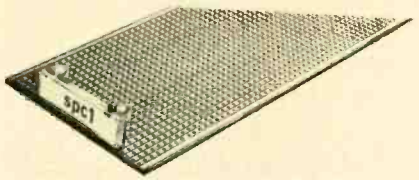


new products

More information of new products is available from the manufacturers of items identified by Reader Service number. Use the Reader Service Card inside the back cover.

PRINTED CIRCUIT CARD HANDLE features a screw-on type handle that incorporates an identification strip. Manufactured in a transparent makrolon material. Available in three colors,



clear, amber, and red. Price in quantity of 1 to 5 packages of 10 handles complete with screws is $2.65 each package.—**Vero Electronics Inc.**, 171 Bridge Road, Hauppauge, N.Y. 11787.

Circle 31 on reader service card

HEAT SHIELDS, *models WP25* and *WP40*. Designed to allow cooling air to flow around the handle of Weller Professional Grade Soldering Irons. Shield is contoured to fit the hand.

25-watt *WP25* and 40-watt *WP40* irons are 7-⅞ in. long and 1-¾ oz; pencil-type soldering tools.

Can be used from tool box or with custom stand (*PH25*) as complete bench station. Other features include stainless steel barrels and double iron-coated industrial quality tips. Weller replacement tips are available in eight figurations. Three-wire cords are also available for either model; they require 120 volts.—**The Cooper Group,** P.O. Box 976, Apex, N.C. 27502.

Circle 32 on reader service card

FOUR-CHANNEL DECODER, *SQ-W (Stock No. 99-03311W)*, incorporates wave matching full-logic decoder circuitry with Vari-blend for high front-to-rear and left-to-right separation of four-channel SQ program material as well as compatible decoding cirucits for other matrix

systems. Provides two composer circuits (A & B) for substantially restoring all other four-channel encoded (matrixed) records to their original four-channel format, and deriving four-dimensional sound from conventional two-channel stero records, tapes, and FM broadcasts.

Features include: two input sensitivity controls; selector switch for SQ full logic, discrete, two-channel, composer A, and composer B; master volume control for adjusting volume of all four channels simultaneously. 2-⅞" x 14-¼" x 11-⅛"; for 117 Vac, 60 Hz; $99.95. —**Lafayette Radio Electronics,** 111 Jericho Turnpike, Syosset, N.Y. 11791.

Circle 33 on reader service card

AMPLIFIER KIT, *model TR-3*. 70-watt-per-channel power amplifier features push-pull operation of all stages and direct coupling throughout. At a steady-state 70 watts into 8 ohms, power bandwidth is 5 to 40,000 Hz ±½ dB. THD is less than 0.1%, and IM is under .07%. Sensitivity can be set so that only .15 volt is needed at input for full output.

Amplifier accepts any load, even capacitive. Push-pull operations reduces problems of

odd-order harmonic distortion, heating, and power supply ripple. Ac-dc feedback loops around output and driver sections and around entire amplifier, plus a dc-only loop overall. 5½ x 8 11½ in.; takes 3 or 4 evenings to assemble; *TR-3D* 2-channel (stereo) $194.90; *TR-3M* single-channel (mono) $142.00. —**Schober Organ Corp.,** 43 West 61st Street, New York, N.Y. 10023.

Circle 34 on reader service card

TV PORT-A-TUNER, *PTS-3001*. VHF/UHF portable television tuner may be substituted for TV set's tuners while they are out of set for overhaul.

Features: two solid-state tuners (82 chan-

nels); high gain, low noise factor; ac powered; completely isolated; neon on/off signal light. Vinyl grain box in green, blue, or black. $49.95 with hookups.—**PTS Electronics, Inc.** P.O. Box 272, 5233 Highway 37 S., Bloomington, Ind. 47401.

Circle 46 on reader service card

AM/FM STEREO RECEIVER, *model Realistic STA-14A* is rated at 25 watts ± 1 dB at 4 ohms; 10 watts rms. Response is 30—15,000 Hz± 3 dB.

Features: magnetic and ceramic phono inputs; FET front end, wideband AM circuitry; switchable afc to pevent drift on FM; separate bass and treble controls; headphone jack; tuning meter;

built-in FM and AM antennas. 5 x 15 x 12½ in.; $109.95, includes $19.95 walnut wood case.—**Radio Shack**, 2617 West Seventh Street, Fort Worth. Tex. 76107.

Circle 35 on reader service card

4-CHANNEL TRANSCEIVER, *model BTL-304.* Two-way radio is FCC type accepted under parts 21, 89, 91, and 93 for operation over low-band frequency range (29—50 MHz). Power output is rated at 30 watts from 13.8-volt dc power source. 0.35-μV receiver has selectivity rated at 6 dB ±7.5 kHz, 70 dB ±15 kHz, and

delivers audio output of 5 watts.

Double conversion i.f. system is 10.7 MHz and 455 kHz. On/off/volume and noise-operated squelch system are operated by front panel controls. VSWR bridge limiting circuitry protects transmitter from final transistor damage. 2⅝ x 6½ x 9½ in.; 6½ lbs.; $349.00, includes high-impedance plug-in ceramic mike and dash mounting bracket.—**Regency Electronics, Inc.** 7900 Pendleton Pike, Indianapolis, Ind. 46226

Circle 36 on reader service card

AUTOMATIC TURNTABLE, *model 710X* features sequential cam shaft drive mechanism. Uses 8 independent pre-programmed cams mounted on central shaft to control automatic functions. Uses heavy, cast, anti-magnetic platters powered by high-torque synchronous motor, connected to variable speed control. Comes with umbrella-type automatic spindle and rotating manual stub spindle.

Pickup arm is low-mass tubular aluminum unit suspended in ball-bearing race, and balanced by resiliently mounted counterweight. Cartridge head can be adjusted for proper stylus overhang, and anti-skating adjustment is provided for spherical and elliptical styli. Uses low friction pivot suspension, and tracks as low as 0.5 grams. Shure M91E elliptical diamond stylus magnetic cartridge is supplied with unit.—**BSR-Metrotec,** Blauvelt, N.Y. 10913.

Circle 37 on reader service card

STEREO CASSETTE DECK, *model 160.* Noise reduction system de-processes Dolby-encoded cassettes or records cassettes. Features high-density heads that minimize tape drag and distortion, and maximize frequency response.

Tape-run indicator light shows direction and mode of tape travel. Has left and right low-impedance mike jacks; 3-digit resettable tape counter for program selection; stereo headphone jack; pause control; removable head cover; electronic governed dc motor for tape speed stability. Two-head, 1-motor cassette deck comes with auto shut-off at end of tape, and has wow and flutter of 0.15 percent, and frequency response from 30 to 13,000 Hz with

standard tape, 30 to 14,000 Hz with chromium dioxide tape. Signal-to-noise ratio is 58 dB with Dolby process; input sensitivity is 0.1 V; output level is 0.30 V. 16½ x 4¾ x 10⅛ in.; 12½ lbs.; $239.50.—**TEAC Corp. of America,** 7733 Telegraph Road, Montebello, Calif. 90640.

Circle 38 on reader service card

STEREO RECEIVER, *model SX-1010* is rated at 100 watts continuous power per channel with both channels driven into 8-ohm loads. Delivers full power at less than 0.1% THD at all audio frequencies from 20 Hz to 20,000 Hz. Features parallel push-pull direct-coupled pure-complementary output stages powered by dual positive-negative power supply that uses total of 36,000 µF of primary filter capacitors. Automatic electronic relay system protects against overload and possible short circuits.

Tone control defeat switch provides flat response over entire audio range and beyond. Dual phono inputs, precision equalized to within ±0.3 dB of standard RIAA, separate

Circle 21 on reader service card

Circle 22 on reader service card

stereo microphone inputs, dual stereo tape deck inputs and deck-to-deck duplication while simultaneously listening to another program source, provide professional studio-console control. Additional inputs and outputs for noise reduction or 4-channel accessories and adapters double as connection points for two more tape decks, if required.

FM tuner section has IHF of 1.7 μV, capture ratio of 1 dB, harmonic distortion of less than 0.2%, and signal-to-noise ratio of better than 72 dB. Phase-locked loop IC circuit insures separation greater than 40 dB; 5-gang variable capacitor in front end, three dual-gate MOSFET's, 7-stage limiter and phase-linear ceramic filters result in 90 dB selectivity and 110 Db of image, i.f. and spurious signal rejection. Unit handles three pairs of speaker systems with any one of two pairs selectable at front panel. Other control features include high-and low-frequency filters, −20 dB audio muting, FM muting, and loudness contour. IHF power bandwidth extends from 5 Hz to 40 kHz; overall frequency response is 10 Hz to 40 kHz, +0 dB, −1 db. Phono overload is better than 250 mV. $699.95 includes walnut cabinet.—**U.S. Pioneer Electronics Corp.,** 75 Oxford Drive, Moonachie, N.J. 07074.

Circle 39 on reader service card

LABORATORY POWER SUPPLY, *model 202S* features current foldback mode in addition to fully regulated voltage and current modes. Rated at 30 volts and 1.5 amps continuous duty, solid state circuitry includes 3 op-amps and solid-state limit and foldback indicators. Output impedance varies from +4 milliohms through zero to −4 milliohms; output capacitance reduces from 1000μF to .47μF while maintaining full loop stability for all real and reactive loads.

Output circuitry is protected against overload as well as positive and negative external forcing within the limits of ±30 V and ±1.5 A. Four selectable meter ranges are provided for monotoring output voltage and current. Operation characteristics include: .01% line and load regulation at full load, ripple and noise of 1 mv/1 mA peak-to-peak and 250μV/250 μA rms, and transient recovery time of 20μsec. $189.00. —**Grumil Corp.,** 4626 Idelwilde Lane S.E., Albuquerque, N.M. 87108. **R-E**

Circle 40 on reader service card

Circle 23 on reader service ca

Circle 24 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.

DISCOUNT MAIL-ORDER CATALOG. 32-page catalog contains tools, service and repair kits, tubes, test equipment, phono cartridges and needles, speakers and microphones, antennas, components, and many other servicing aids. Manufacturers' brands include Workman, Zenith, RCA, Wahl, Weller, Arco, TeleMatic, Mura, Shure, EICO, Arista, etc. —**Fordham Radio Supply Co.,** 558 Morris Avenue, Bronx, N.Y. 10451.

Circle 41 on reader service card

THE WORLD OF SWL'ING. 16-page booklet features receivers, books, accessories, clocks, antennas, headphones, and shortwave portable receiver. Contains illustrations and prices of each item. Order form and business reply envelope are enclosed.—**Gilfer Associates, Inc.,** P.O. Box 239, Park Ridge, N.J. 07656.

Circle 42 on reader service card

SEMICONDUCTOR PRODUCT GUIDE, 142-page catalog contains semiconductor device installation notes, transistors, silicon FET's, diodes/rectifiers, multi-diode devices, Zener voltage regulators, multipliers, color oscillator crystals, IC's, light-emitting diodes, exact replacement and industrial diode devices, how to read PTC semiconductor cross reference, and PTC semiconductor cross reference. —**Mallory Distributor Products Co.,** Box 1284, Indianapolis, Ind. 46206.

Circle 43 on reader service card

QUICK REFERENCE FOR YOKE ADAPTERS & CONVERGENCE LOADS chart lists Admiral, AMC, Channel Master, Curtis-Mathes, Dumont or Emerson, Heathkit, GE, Magnavox, Packard Bell, Panasonic, RCA, Sanyo, (Sears) Silvertone, Sylvania, Westinghouse, Toshiba, Zenith, and many others. Also contains test rig for tube and solid-state sets, adapter kits, test-jig adapters, transverter, color CRT checker, crystal checker, and portable substituter.—**TeleMatic,** 2245 Pitkin Avenue, Brooklyn, N.Y. 11207.

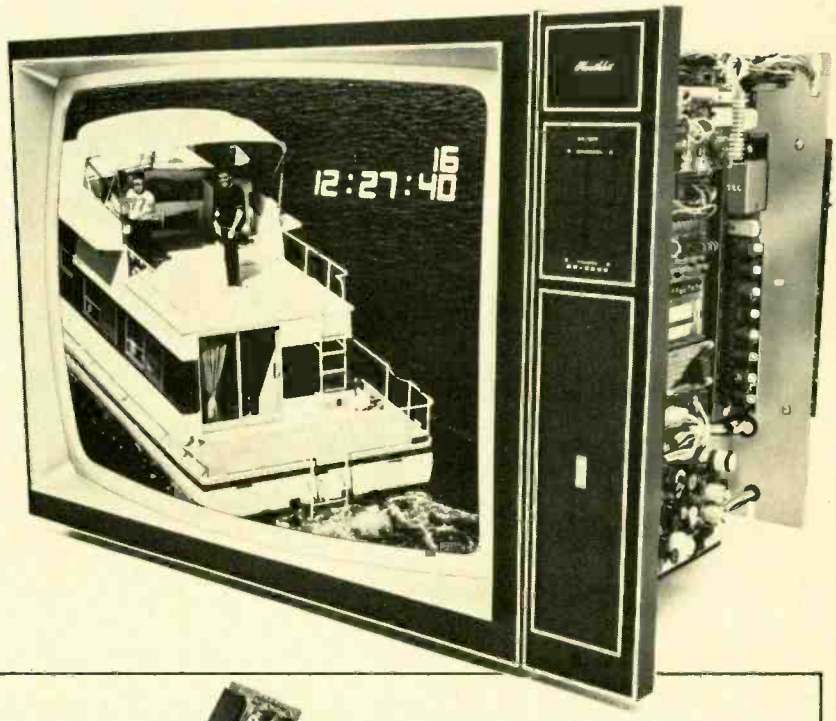
Circle 44 on reader service card

SANYO VIDEO-VISION VTC 7100. 16-page color brochure contains complete specifications, advanced features, and suggested applications of the *VTC7100* video cassette recorder for business, education, and industry.—**Sanyo Electric Inc.,** Communications Products, 1200 West Artesia Blvd., Compton, Calif. 90220.

Circle 45 on reader service card

GLOSSARY OF METRIC CONVERSIONS. 18 pages of over 1100 conversions —metric, physics, electrical, and electronic. Page on metric measurements only; section on useful physical constants, prefixes used in metric system, and Greek alphabet. For non-technical as well as technical people.—**Henry Lavin Associates, Inc.,** 12 Promontory Drive, Cheshire, Conn. 06410. **R-E**

READ WHAT THE EXPERTS SAY ABOUT THE NEW HEATHKIT DIGITAL COLOR TV

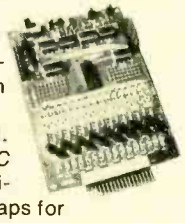


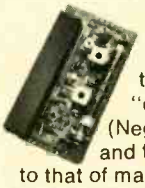
"The editors of RADIO-TV REPAIR said, "With manufacturers only now beginning to get the color excellence Heath has featured for years, it was time for Heathkit to once again move ahead of the industry, and move they did..."

According to RADIO-ELECTRONICS, the Heathkit GR-2000 Digital Color TV "uses so much digital design and so many integrated circuits...it sets new standards for state-of-the-art in color TV".

The RADIO-ELECTRONICS editors said the Heathkit Digital TV has "features that are not to be found in any other production color TV being sold in the U.S.:

"On-screen electronic digital channel readout...numbers appear each time you switch channels or touch the RECALL button...*On-screen electronic digital clock*...an optional low cost feature...will display in 12- or 24-hour format...*Silent all-electronic tuning.* It's done with uhf and vhf varactor diode tuners...*Touch-to-tune, reprogrammable, digital channel selection*...up to 16 channels, uhf or vhf...in whatever order you wish...there's no need to ever tune to an unused channel. *LC IF amplifier* with fixed ten-section *LC IF bandpass filter* in the IF strip...eliminates the need for critically adjusted traps for eliminating adjacent-channel and in-channel carrier beats. No IF alignment is needed ever. *Touch volume control*...when the remote control is used...touch switches raise or lower the volume in small steps."





POPULAR ELECTRONICS took a look at the 25-in. (diagonal) picture and said it "can only be described as superb. The Black (Negative) Matrix CRT, the tuner and IF strip, and the video amplifier provide a picture equal to that of many studio monitors..."

Furthermore, the Heathkit GR-2000 is an easier kit-form TV to build. POPULAR ELECTRONICS pointed out that "Each semiconductor has its own socket and there are 12 factory-fabricated interconnecting cables...The complete color adjustments can be performed in less than an hour."

And here's what RADIO-TV REPAIR said about service: "...virtually every function of the TV receiver has been broken down to a miniature plug-in circuit assembly... if trouble develops you simply pop out the correct board and check it yourself...Heath provides free technical consultation, and if you do need factory service, as we said, the costs are low, well below that for (conventional color TV) insurance protection."

To sum up, POPULAR ELECTRONICS concluded its study by stating, "In our view, the color TV of the future is here—and Heath's GR-2000 is it!"

Why not see what the experts have seen? The Heathkit Digital Color TV—without question the most remarkable TV available today. Mail order price for chassis and tube, $649.95. Remote Control, $79.95 mail order. Clock, $29.95 mail order. Cabinets start at $139.95. (Retail prices slightly higher)."

Heathkit electronics- today's technology is in your hands

A. Heathkit IB-1103 180 MHz Counter has phase-locked multiplier, extremely high resolution with 8½-digit readout. Pushbuttons permit multiplication by 1 (direct), 10, 100 or 1000. Also has temperature compensated crystal oscillator (TCXO) and pushbutton selection of 1 msec., 100 msec. and 1 sec. gate times. Input sensitivity is 50 mV to 120 MHz and 100 mV to 180 MHz. Has lighted indicators for MHz, kHz, Hz, Gate, Overrange and unlocked conditions. $379.95*. Shipping weight, 12 lbs.

B. Heathkit ID-1290 Weather Station has Uni/Mag® barometer for 2½ times greater pointer deflection; 8 wind-direction compass points that light-up in combination to give you 16-point resolution; wind speed indicator with 2 switch selectable ranges, 0-30 and 0-90 mph; dual-sensor thermometer with switch selection of indoor and outdoor temperatures. Includes weather cup and wind vane assembly, simulated walnut housing. $89.95*. Weight, 9 lbs., 50′ cable, 5.95*, 2 lbs.; 100′, 9.95*, 4 lbs.; 150′, 14.95*, 6 lbs.

C. Heathkit GC-1005 Electronic Alarm Clock. A six-digit timepiece that displays hours, minutes and seconds on highly visible cold-cathode readout tubes. Gentle "beeper" alarm can be set for 24-hour cycle, features snooze switch for seven more minutes of sleep. Displays time in 12-hour, or 24-hour format. $54.95*. Mailing weight, 4 lbs.

D. Heathkit ID-1390 Digital Thermometer. A solid-state device that monitors indoor and outdoor temperatures. Switches set thermometer for alternate display of indoor/outdoor temperature at 4-second intervals, for constant display, and for readout in either degrees Fahrenheit or degrees Centigrade. Includes 85′ cable and 2 sensors. $59.95*. Mailing weight, 5 lbs.

E. Heathkit AR-2020 4-Channel Receiver offers 25 watts music power per channel, built-in decoder for reproducing matrixed 4-channel material, and an AM/FM tuner that boasts 2μV sensitivity, 2dB capture ratio. There are individual front panel controls for all four speakers plus a "master" control, pushbuttons for all modes of operation and inputs to accommodate phono, tape and auxiliary source in stereo or 4-channel combinations. The solid-state circuitry mounts on modular plug-in boards for easy assembly and self-service. And the low kit price includes the cabinet, too! $249.95.* Mailing weight, 31 lbs.

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Units of Schlumberger Products Corporation
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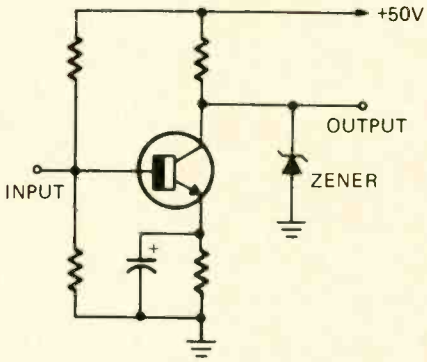
Circle 100 reader service card

circuits

PROTECTING A TRANSISTOR

Occasionally we want to operate a resistance-capacitance coupled solid-state amplifier from a power supply delivering a voltage much higher than the maximum rated collector-to-emitter potential of the transistor. Under normal operating conditions, the IR drop across the collector resistor keeps



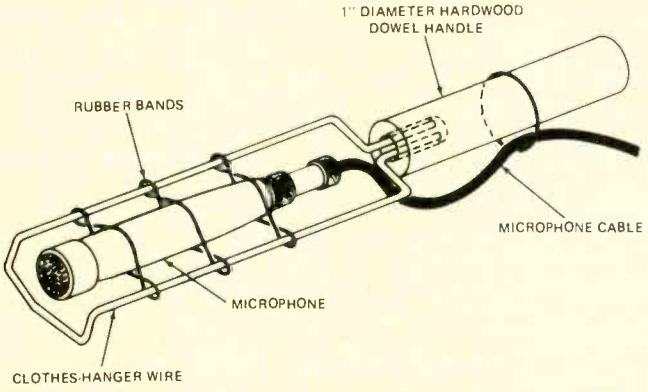
the collector voltage at a safe level. If, however, the base current is driven too low, the collector current also goes low, and the voltage at the collector can rise high enough to damage the transistor.

To prevent such damage without any doubt about it is to

connect a ¼-watt Zener diode between collector and ground, as shown in the diagram. The Zener voltage of the diode should be just below the transistor's maximum collector-to-emitter potential. Thus, for a 25-volt transistor use a 22-volt Zener diode. The transistor may be operated at 12 volts at the collector. At this level, a good Zener diode represents practically an open circuit. Should the collector potential rise to 22 volts, however, the diode goes into conduction and clamps the collector at the 22-volt level.—*Frank H. Tooker*

SHOCK ABSORBING MICROPHONE

And old clothes hanger, a short section of 1 inch diameter hardwood dowel and four rubber bands can be transformed into an effective shock absorbing suspension for sensitive microphones. You can do it in just a few minutes. The mounting shown in the drawing was designed for hand-held



SHOCK ABSORBING MICROPHONE SUSPENSION

use with a battery powered portable tape recorder. It has effectively removed all noises formerly caused by motion of the mike cable and hand movements on the mike body.—*Dr. James B. Young* **R-E**

MATV SYSTEMS

(continued from page 44)

protection. But *impedance match* rates top attention. Using a transformer to convert a 300-ohm antenna array to 75 ohms can introduce a lot of loss. The gamma match serves far more effectively.

The log-periodic design, cut to channel with sharp skirts, takes high marks for uhf reception. Sometimes a dish reflector is the only way to get a high enough front/back ratio, however.

What eventually goes wrong?

In a properly designed and installed system, deterioration is very slow. To reduce even the effects of that, Commercial Electronics, Inc., technicians prepare a proof-of-performance sheet for every system they install. Measurements are taken at splitters, in and out of amplifiers, at antenna downleads, and at output taps. This written report serves two purposes. Performance can be compared to specifications on the original bid. More significantly, operation in two years or five years can be compared and steps taken to counter any noticeable degradation. The proof-of-performance sheet makes the slightest falloff easily spotted and diagnosed.

Most service problems come from specific failure, usually some amplifier trouble. A carefully equipped repair department lets technicians troubleshoot and fix defects, and also measure every performance parameter to make sure the "black box" exhibits no impending difficulties.

How long should a system last? Ten years is common, if the antenna has been prudently mounted away from chimneys and industrial smog. Salt air works hard on antennas, although special coatings help. Triaxial cable lasts longer than coaxial, although its usual purpose is to reduce heavy rf noise. The outer shield is grounded every few feet; the inner shield goes to ground only at each end, as with regular coaxial cable.

CATV and MATV

Most cities soon will have cable TV. Where does that leave MATV installations? Compatibility with cable television takes very little extra trouble, say Colip and Abraham. The chief alteration is changing to broadband amplifiers from strip-type mixers.

One major secret lies in derating the distribution sytem enough to make up for whatever crossmodulation and signal/noise degrading exists already in the cable system. If the cable signals already approach that figure, you run the MATV amplifiers so well inside their ratings that virtually no degradation is added. This takes careful measurement and analysis of the incoming signals, plus critical examination and calculation of the specs of amplifiers you wire into the master distribution system. Again, the minicomputer proves a handy tool, although manufacturers can usually supply dependable derating curves for their amplifiers.

What if a master-antenna owner wants to bring in a 12-channel cable signal, yet also use some master-system channels for monitoring or other purposes of his own? (Some master distribution systems carry live or movie fare on their own program channels.) With 12 vhf cable channels occupied, you resort to midband or superband channels, or sometimes subchannels. They are the same as have long been intended for 20-channel (and up) cable TV systems. Most TV receivers on the system then need converters.

It's surprising how alike master systems and cable television have become. One master system C-E is working on right now will resemble a small CATV hookup. It is to serve more than a hundred mobile homes in a trailer-park setting. Half-inch aluminum cable will carry signals from pole to pole, with CATV-type drops to each mobile home. Later, a modulator can be added, much as in done in hospitals and schools, allowing the manager a channel for messages, live programs, or movies.

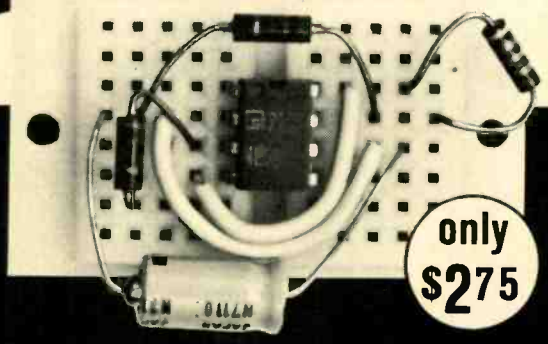
You could say MATV is headed in the direction of cable television, at least technically. Equipment has grown versatile and sophisticated. With competent design, a master antenna setup can do everything a cable system will be expected to do, including two-way video communication.

If you want in on the progress, talk to the MATV antenna and accessory manufacturers. They have the tightest handle on what's happening. Get yourself ready. **R-E**

LET US KNOW

If you thought that this article on MATV was great; or if you hated every word of it; would you please let us know? A postcard will do. Address it to: Editor, Radio-Electronics Magazine, 200 Park Avenue South, New York, N.Y. 10003.

the NEW



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- Low insertion force
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- Horizontal interconnecting matrices
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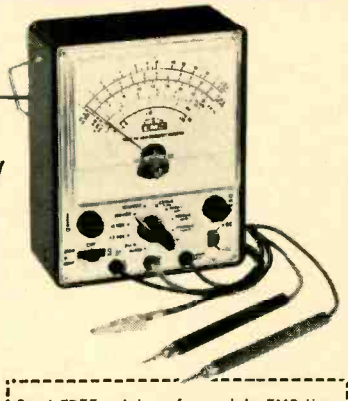

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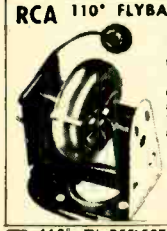

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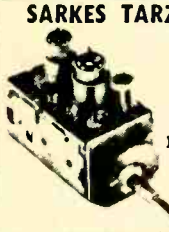

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3¼" — 600'	.68
5" — 600'	.72
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5" — 1800'	1.59
7" — 1200'	.87
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Circle 70 on reader service card

94 *Circle 71 on reader service cards*

BANDPASS FILTERS

(continued from page 41)

As a *"rusty pendulum"*, you can use it as an electronic chime, bell, drum, or bongo. Here, you put a pulse or a very low-frequency squarewave into the circuit, shock exciting the tank, and letting it ring, giving you an exponentially decaying sinewave. For instance, if you drive the Fig. 2 circuit from a 1 hertz squarewave, you ring the chime twice each second, once on the leading and once on the trailing edge of the square wave. If you key your chime, always be sure to eliminate any switch noise and bounce to keep you from getting multiple hits.

As an *oscillator*. If you remove the Q-determining resistor, the circuit will usually be on the verge of oscillation. You can Raise R4 slightly or change the supply to a lower value to get a low-distortion sinewave oscillator. As with any oscillator of this type you or some negative feedback circuit has to ride the gain to hold low distortion and constant amplitude.

Highpass and lowpass functions can also be obtained by adding a resistor or two, but there are no real advantages in the Biquad over simpler active highpass and lowpass circuits. Only in the bandpass case does it really perform.

R-E

Circle 72 on reader service cards

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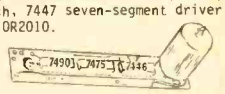

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74H05	.35
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74H08	.35
7410	.25
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7413	1.25
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7420	.25
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74H20	.35
74H22	.35
7430	.25
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7440	.25
74H40	.35
7441	1.25
7442	1.20
7446	1.20
7447	1.50
7448	1.00
7450	.25
74H50	.35
7451	.25
74L51	.30
74H51	.35
7453	.20
7454	.25
74L54	.35
74L55	.35
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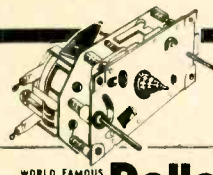

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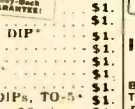

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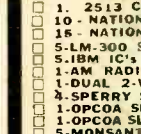

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☐	SN7432	.35
☐	SN7437	.49
☐	SN7438	.52
☐	SN7440	.24
☐	SN7441	1.19
☐	SN7442	1.12
☐	SN7443	1.12
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- ☐ SN74123 10 for $1.
- ☐ SN74154 5 for $1.
- ☐ SN74181 3 for $1.
- ☐ SN74192 5 for $1.
- ☐ SN74193 5 for $1.

Includes factory-good, rejects & defects, who knows at these prices!

SALE! 6 AMP QUADRACS *With jumbo "Top Hat" heat sink

Money-Back GUARANTEE on all Items

PRV	SALE
☐ 25	$ .88
☐ 50	1.25
☐ 100	1.95
☐ 200	2.49
☐ 400	2.98
☐ 600	3.50
☐ 800	3.98

"C-MOS" IC CIRCUITS

☐	74C00	$ .59
☐	74C04	.89
☐	74C10	.59
☐	74C20	.59
☐	74C42	1.95
☐	74C73	1.50
☐	74C74	1.30
☐	74C76	1.50
☐	74C107	1.25
☐	74C151	2.50
☐	74C154	2.95
☐	74C157	1.95
☐	74C160	2.95
☐	74C161	2.95
☐	74C162	2.95
☐	74C163	2.95
☐	74C195	2.75

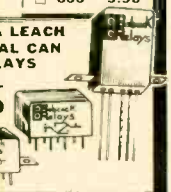
RCA TYPE "C-MOS" IC's

		Sale
☐	CD4001AE	$ .61
☐	CD4002AE	.61
☐	CD4009AE	.95
☐	CD4010AE	.61
☐	CD4011AE	.61
☐	CD4012AE	.61
☐	CD4013AE	1.25
☐	CD4016AE	1.25
☐	CD4019AE	1.25
☐	CD4023AE	.61
☐	CD4025AE	.59
☐	CD4035AE	2.50

"AEROSPACE" BABCOCK & LEACH CRYSTAL CAN RELAYS

All hermetically sealed. Submini, 1/6, half, and full crystal can types in 6-12-24V in asst contacts up to 4PDT, 1 amp up 10 amps. Such types as BR40, 41, 10, 44, 16, 24, etc. Sorry, no choosing voltages or types. From factory mixtures . . . to you! Good asst. if you are space-minded, at low prices.

12 for $3.50 ☐



HI-FI AUDIO IC'S

	Type	Description	Code	Sale
☐	WC-334	1-W Audio Amp	TO-5 - (W)	$1.49
☐	PA-263	3-W Audio Amp	DIP - (G)	2.50
☐	MFC-9000	4-W w/Pre Amp	DIP - (M)	3.50
☐	SN76024	4-W Audio Amp	DIP - (T)	3.95
☐	TBA-800	5-W Audio Amp	DIP - (A)	5.95
☐	ULX2277	4-W Stereo	DIP - (S)	2.50
☐	LM-380	2-W Audio Amp	DIP - (N)	1.50

Code: W-Westinghouse, G-G.E., M-Motorola, T-Texas, A-Ates, S-Sprague, N-National

INTEGRATED CIRCUIT SOCKETS

Buy Any 3 Take 10% Discount!

- ☐ 14-Pin, DIP $.45
- ☐ 14-Pin, Wire Wrap .59
- ☐ 14-Pin, Side Mount 1.00
- ☐ 16-Pin, DIP .50
- ☐ TO-5, 8 or 10-Pins .29

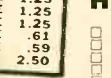
NATIONAL 'OP' AMPS

Type BUY ANY 3 — TAKE 10%

	Type		Sale
☐	LM-300	Super 723 V. reg.	$0.91
☐	LM-301	Hi-performance amp	.41
☐	LM-302	Voltage follower	.91
☐	LM-305	Pos. V. reg.	1.19
☐	LM-307	Super 741	.41
☐	LM-308	Hi-Q Fet Type Op Amp	1.19
☐	LM-309H	5V 200 mil V. reg.	1.19
☐	LM-309K	5V 1-amp V. reg.*	1.85
☐	LM-311	Comparator	1.19
☐	LM-319	Hi-Speed Dual comp	1.55
☐	LM-320	Minus 5V 1-amp V.R.*	1.75
☐	LM-320	Minus 12V 1-amp V.R.*	1.75
☐	LM-320	Minus 15V 1-amp V.R.*	1.75
☐	LM-350	Dual peripheral driver	.41
☐	LM-370	AGC squelch op amp	1.19
☐	LM-371	R-F, I-F, op amp	1.25
☐	LM-373	AM-FM, SSB, I.A.D.	3.75
☐	LM-374	AM-FM, SSB, IVAD	3.75
☐	LM-380	2-watt audio amplifier	1.69
☐	LM-3028	Differential RF/IF amp	1.50
☐	LM-3070	Chrome regenerator	1.00
☐	LM-3071	TV chroma IF amp	1.00

*TO-3 case, — others TO-5

"MEMORY LANE"



Buy Any 3 — Take 10%

☐	1101	256 Bit RAM MOS	
☐	1103	1024 Bit RAM "4OS	$2.50
☐	2516	Character Gen. ROM	7.50
☐	7489	64 Bit RAM TTL	12.50
☐	8223	Programmable ROM	2.95
☐	MM5520	Pre-Programmable ROM	6.50
☐	MM5260	1024 Bit RAM	2.95
☐	MM5262	2048 Bit RAM	7.95
			9.95

LINEAR Op Amps

FACTORY GUARANTEED — FACTORY TESTED — FACTORY MARKED

☐	531 Hi slew rate op-amp (TO-5)	$2.50
☐	532 Micro power 741 (TO-5)	2.50
☐	533 Micro power 709 (TO-5)	2.50
☐	536 FET Input op amp (TO-5)	2.95
☐	550 Precision 723 voltage reg. (DIP)	1.17
☐	555 Timer 2 u Seconds to 1-hr, (A)	1.25
☐	556 5 Times faster than 741C	2.10
☐	558 Dual 741 (A)	1.00
☐	560 Phase lock loops (DIP)	2.95
☐	561 Phase lock loops (DIP)	2.95
☐	562 Phase lock loops (DIP)	2.95
☐	565 Phase lock loops (A)	2.95
☐	566 Function generator (TO-5)	2.95
☐	567 Tone decoder (A)	2.95
☐	702C Hi-grain, DC amp (TO-5)	.49
☐	703C RF-IF, amp, 14 ckts (TO-5)	.69
☐	704 TV sound IF system	1.50
☐	709C Operational amp (A)	.33
☐	710C Differential amp (A)	.47
☐	711C Dual diff. comp (A)	.47
☐	723C Voltage regulator (A)	.75
☐	733 Diff. Video Amp	1.75
☐	741C Frequency compensator 709 (A)	.44
☐	741CV Freq. comp 709 (Mini DIP)	.49
☐	747C Dual 741C (A)	.89
☐	748C Freq. adj. 741C (A)	.69
☐	753 Gain Block	1.75
☐	739-739 Dual stereo preamp	1.98
☐	741-741 Dual 741C (TO-5)	.89
☐	PA265 5-Watt voltage regulator	1.50
☐	ULN2300M Op amp with SCR	1.50
☐	CA3065 Video Audio system	1.05
☐	4250 Programmable Op Amp	2.50
☐	4136 Quad 741's (DIP)	1.95
☐	75451 Dual peripheral driver	.44
☐	75453 Dual peripheral driver	.44
☐	75491 Quad seg driver for LED readouts	1.65
☐	75492 Hex driver w/col. out 250 ma.	1.85

For LED readouts (A) TO-5 or DIP dual in line pak

BUY ANY 3 — TAKE 10%

SILICON CONTROL RECTIFIERS

PRV	1A	3A	8A**	25A*	100A*	250A*
15	☐ $.15	—	—	—	—	—
30	☐ .25	☐ $.39	—	—	—	—
60	☐ .39	☐ .52	☐ $.55	☐ $.95	☐ $2.25	☐ $5.50
100	☐ .49	☐ .69	☐ .60	☐ 1.25	☐ 2.95	☐ 6.95
200	☐ .69	☐ .89	☐ .69	☐ 1.95	☐ 3.95	☐ 8.50
400	☐ .95	☐ 1.19	☐ 1.25	☐ 2.50	☐ 5.95	☐ 10.50
600	—	—	☐ 1.50	☐ 2.96	☐ 7.95	☐ 12.50

*Stud. **Plastic, power tab. Others TO-18,5.

HIGH POWER STUD RECTIFIERS

PIV	50A	250A
50	☐ $.69	☐ $4.50
100	☐ .85	☐ 6.50
200	☐ 1.19	☐ 8.25
400	☐ 1.45	☐ 9.95
600	☐ 1.75	☐ 10.50
800	☐ 2.25	☐ 11.50
1000	☐ 2.65	☐ 12.50

STUD & TO-5 TRIACS

PRV	3A*	6A*	15A	25A
50	☐ $.25	☐ $.30	☐ $.75	☐ $.95
100	☐ .49	☐ .40	☐ .95	☐ 1.15
200	☐ .49	☐ .70	☐ 1.19	☐ 1.50
300	☐ .59	☐ .90	☐ 1.50	☐ 1.90
400	☐ .69	☐ 1.10	☐ 1.90	☐ 2.25
500	☐ .79	☐ 1.50	☐ 2.25	☐ 2.75
600	☐ .99	☐ 1.75	☐ 2.50	☐ 2.95

*In TO-5 case, others stud

Terms: add postage Rated: net 30

Phone Orders: Wakefield, Mass. (617) 245-3829

Retail: 16-18 Del Carmine St., Wakefield, Mass. (off Water Street) C.O.D.'S MAY BE PHONED

☐ 15¢ CATALOG on Fiber Optics, 'ICs', Semi's, Parts

POLY PAKS

P.O. BOX 942R, LYNNFIELD, MASS. 01940

Circle 93 on reader service card

ADVERTISING INDEX

RADIO-ELECTRONICS does not assume responsibility for any errors which may appear in the index below.

(continued on page 100)

Opto Electronics Sale

LIGHT EMITTING DIODE GaAs INDICATORS

- ☐ 2-MV1, amber, visible jumbo epoxy lens upright $1.00
- ☐ 1-MV2, TO-18, dome, green, visible 1.00
- ☐ 1-MV2, green small dome, green diff. lite 1.00
- ☐ 1-MV2, clear small plastic dome, green diff. lite 1.00
- ☐ 1-MV3, micro-mini 'pin head' dome, TO-18, green lite 1.00
- ☐ 6-MV3, visible, "coax pin pak", red, mini dome lens 1.00
- ☐ 1-MV4, stud, high power, red, 2-watts 3.95
- ☐ 1-MV4H, stud, high power, hi-dome, red, 2-watts 3.95
- ☐ 6-MV10B, visible, red, clear dome lens TO-18 ..... 1.00
- ☐ 6-MV10C, visible, red, diffused, dome lens, TO-18 ..... 1.00
- ☐ 6-MV50, axial leads, micro-mini dome, clear, red, TO-18 ..... 1.00
- ☐ 1-MV52, micro-mini, axial green lens, green lite 1.00
- ☐ 1-MV53, micro-mini, axial yellow lens, yellow lite 1.00
- ☐ 6-MV54, micro-mini, axial leads, red lens, red lite 1.00
- ☐ 6-MV55, micro-mini, axial leads, red lens, red lite 1.00
- ☐ 6-MV5012, red small dome lens, red lite, TO-18 ..... 1.00
- ☐ 6-MV5013, sm. dome, 2 hi red dome, soft red diff. lite, TO-18 ..... 1.00
- ☐ 6-MV5020, jumbo clear dome, visible, red, TO-18 ..... 1.00
- ☐ 1-MV5040, 4-LED red array, with 5-lead pak 1.49
- ☐ 6-MV5054, red jumbo dome lens, TO-18 red lite, upright 1.00
- ☐ 6-MV5080, TO-18, micro-mini red dome, red lite 1.00
- ☐ 6-MV5080, TO-18, micro-mini flat clear lens, red lite 1.00
- ☐ 1-MV5094, red bi-polar, solid state lamp V to 110-115VAC-DC 1.98
- ☐ 2-MV5222, green jumbo dome, green lite, panel snap-in 1.00
- ☐ 2-MV5282, micro-mini, green lens TO-18, green lite 1.00
- ☐ 2-MV5322, yellow jumbo dome, yellow lite, panel snap-in 1.49
- ☐ 1-MV5491, jumbo, Tri-State, RED, GREEN, OFF, special 1.98
- ☐ 2-MT2, photo transistor, light sensor, TO-18 ..... 1.00

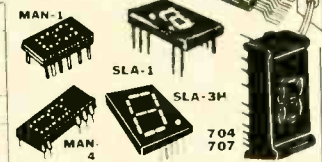
7-SEGMENT *LED Readouts*

(All "LED" TYPES)

Type	Char.	Each	Special
MAN-1	.27	$3.75	3 for $9.
MAN-3	.12	1.49	3 for $3.
MAN-4	.19	2.50	3 for $6.

REFLECTIVE BAR TYPES

707*	.33	2.50	3 for $6.
704*	.33	2.50	3 for $6.
SLA-1**	.33	2.10	3 for $5.
SLA-3**	.70	4.95	3 for $13.
SLA-11**	.33†	3.50	3 for $10.



*By Litronix. **By Opcoa, equal to MAN-1 or MAN-4 specs. Color - RED. †Green.

GIANT SALE ON 3-DIGIT READOUTS

$2.50 3 for $6

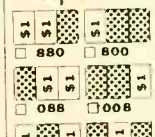
☐

Made by National, their Type NSN-33. With red lens filter. Properly multiplexed. Three digits size of MAN-3. Driver SN7448. 10 mils. Case only 9/16 x 3/8 x 1/16"; 12-pins. For pc boards, or fits into standard IC socket. For calculators, DCMS, DVM, Clocks and 1000's of indicating devices. Price is lowest we have seen! 100% perfect. Buy all good digits, not rejects as the Hewlett Packard's advertised by others.

READOUTS BY THE DIGIT!

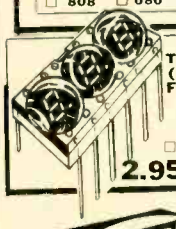
LOWEST PRICE ANYWHERE! ANY 3 DIGITS—TAKE 10%

$1. Per Digit 100% good



☐ 880 ☐ 800 ☐ 088 ☐ 008 ☐ 808 ☐ 080

Poly Paks buy complete National inventory of 1-digit missing NSN-33. Same as the $2.50 unit except 1-digit out. Properly multiplexed, so that you may use 2 of the units. Line-up, as you wish and get the desired combination. Zero means that digit is missing. Numeral 8 meaning 100% good unit. LOWEST PRICES ANY WHERE. Imagine not $1.80 per digit, but $1.00 per digit. WHY PAY MORE! **Order by digit and save $$$$**



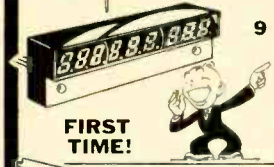
GET MORE DIGITS FOR LESS!

THREE (9-digits) FOR $8.

LITRONIX DL-33B 3-DIGIT LED READOUTS

2.95

14-pin version of the NSN-33, or the DL-33 except has BLISDOR lenses like the Hewlett Packard version, except these are 100% and NO DIGITS MISSING! and LOWER IN PRICE! Properly Mux'd, same specs as MAN-3 but magnified SN7448 driver. With spec. sheets. Fits into 14 pin IC socket.



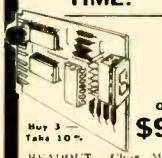
FIRST TIME!

WHY BUY MULTIDIGIT REJECTS!

9 DIGI-METER READOUT FOR PANEL INDICATION

☐ **$14.95** Buy 3 take 10%

Imagine, nine 7-segment MAN 3's mounted in a red molded plastic 2½" x 1" x ½" meter like case. Properly multiplexed. For PC use. Unique panel-like construction lends itself to 1000's of DIGI-METER applications for hand-held, panel and table instruments. Instructions.



LED MITY DIGIT "DCM'S"

*Your choice of 5 red LED readouts!

☐ Only **$9.99** Buy 3 — Take 10%.

Scientific Devices "Digital Counting Modules" outperform any other DCM on the market today. More features than ever before! Not gaseous, not incandescents, not nixie but the modern LED. Choose from such famous manufacturers as Monsanto's MAN-1, MAN-4, Litronics 707 and 704, Opcoa's SLA-1 (the last 4 having character heights of 0.33 at no extra charge). Each kit Includes 3x2" p.c board with fingers for a FREE edge connector, side-mounting dip socket. LED readout of your choice, resistors, 3 IC's, and Molex connectors (this ELIMINATES SOLDERING YOUR IC's), and booklet, **INCLUDES P.C. EDGE CONNECTOR — FREE!**

READOUT	Char.	Maker
☐ MAN-1	.27 h.	Monsanto
☐ MAN-4	.19 h.	Monsanto
☐ 707*	.33 h.	Litronics
☐ 704**	.33 h.	Litronics
☐ SLA-1*	.33 h.	Opcoa

* Pin-for-pin MAN-1, ** Pin-for-pin MAN-4, elec. char. same

Your choice **$2.50**

MUX'D DIGITAL CLOCK PC BOARD

☐ MAN-1 ☐ Litronics 707 (MAN-1*)
☐ MAN-3 ☐ Litronics 704 (MAN-4**)
☐ MAN-4 ☐ Opcoa SLA-1 (MAN-1*)

☐ 6-MAN-3A's for above board, $9.50

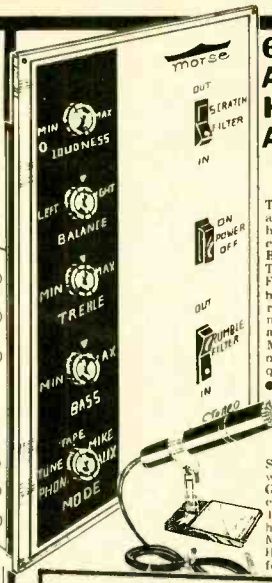
Each board properly multiplexed for 6 digits, to hold MAN-1's, MAN-3's, MAN-4's. Litronics 707 (MAN-1) and 704 (MAN-4), and Opcoa's SLA-1 (MAN-1). Board 6⅞" long with spec sheets.

* Elec char. same as MAN-1 or 4.

☐ MM5311	6-digit	28-Pin	$ 8.88
☐ MM5312	4-digit	24-Pin	8.88
☐ MM5313	6-digit	28-Pin	8.88
☐ MM5314	6-digit	24-Pin	8.88
☐ MM5316	4-digit	40-Pin, Alarm	13.50

CLOCK CHIPS ON A "DIP" ANY CHIP **$8.88**

☐ 1-MM5316, DIGITAL ALARM CLOCK FACTORY FALLOUT — $1.49 EA



60-WATT STEREO AM-FM-MULTIPLEX HIGH FIDELITY AMPLIFIER

INFLATION-FIGHTING ☐ Only **$49.95**

- Wall "Slim-Line" Type!
- Tape, Record Player, PA & Musical Instruments!

The most amazing audio offer for the hi-fi-ers, PA men, and an ideal unit for the family den, or any room in the house, office, etc. Comes complete with hookup, escutcheon, and knobs. 5 separate controls: LOUDNESS, BALANCE, TREBLE, BASS, circuits switch for PHONO, TUNER, TAPE, MIKE, AUX, 3 switches for SCRATCH FILTER, RUMBLE FILTER, and POWER "ON-OFF" with built-in lite. 4-output transistors, each 30 watts. Separate accessory mounting panel for 4 speaker attachment, mike and musical instrument jack, tape, tuner, and power jacks. 6-ft. cord set for 115VAC, 60 cycles. Measures only 13 x 7 x 3". Wt. 3 lbs. With attractive multi-color escutcheon. Made by leading US maker of quality amplifiers.

- 20-20,000 Cycles Resp
- 4-Channel Spkr. Systems!

"THE PRO" — HI-Q DYNAMIC

PENCIL MIKE

☐ Only **$6.95**

Sold elsewhere for over $10. All metal construction, with stand, 6-ft. cord, and standard mike plug. By General Electric. NO IMPORT! Highly polished with chrome trim. Omni-directial, 20,000 ohm imp., 60 to 100Khz freq resp. Crisp, ultra-sensitive, high quality, hi-fidelity. Ideal for PA, CB, and all HAM equipment. May be hand-held too! Mike 5" long 1" dia., with taper. Heavy-duty grey metal stand, 2½ x 2¾ x 3½". Ideal for our 60w stereo Amp. wt. 1-lb.

KRONOS WITH "TIME BASE"*

Cabinet is 6" x 5½" x 6".

$47. Any Type Clock less time-base

NEW FOR 1974!

* with TIME BASE **$64.95**

CHOOSE YOUR READOUT

Type	LED	Charac.	Sale
☐ KR-101	MAN-3	.12	$47.
☐ KR-103	MAN-4	.19	47.
☐ KR-104	Nixie*	.45	47.
☐ KR-105	707†	.33	47.
☐ KR-106	704†	.33	47.
☐ KR-107	SLA-1†	.33	47.
☐ KR-108	Same as SLA-1 but GREEN, add $12.		

† "MAN" LED readouts are "all LEDs" but the Litronix 707 and Opcoa SLA-1, like the MAN-1, are of the reflective bar segment technique, the 704 is the reflective bar version of the MAN-4. *The Nixie tube is a 7-segment device as others.

- Now two clocks in one!
- For 12VDC* 110VAC!
- Now adaptable to boats, planes & cars too!
- One price for any LED!
- The only clock of its kind in USA today!
- 12 or 24-hr clock

Scientific Devices introduces the new any LED Kronos digital clock. That's right, you can choose the "ALL-LED" Man-1, Man-3, and Man-4, and the new reflective bar types with the larger digits, at only one price, $47. This is a Scientific Device first! We even hav have more . . . for $19.95 we have available as an (*) extra option to Naval Observatory your clock, or making it an all-purpose all-duty unit. For indoor and outdoor activity. This **"TIME BASE"** is the simplest on the market today with the help of one of the largest time base manufacturers for the famous digital wrist watches. Therefore, current drain is negligible, not like other cumbersome types. It's easy to construct, easy to slip into the Kronos of your choice and connect with easy instructions. Its overall design is simple and easy to construct. The kit is complete with famous black-and-white TEN-TEC cabinet, plus all accessories and booklets. Features include 3 setting controls, 1-hour per second, 1-minute per second, and hold button. KR100 series is a Scientific Device exclusive!

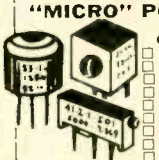
CRYSTAL TIME BASE FOR ANY KRONOS*

☐ **$19.95**

Includes precision crystal, time-base IC, pc board & accessories with info.

*Not for KR-104

SPECTROL CERMET "MICRO" POTS



Your Choice **Any 2 for $1**

Ohms	
☐ 10	
☐ 20	
☐ 50	
☐ 100	
☐ 200	
☐ 500	
☐ 1K	
☐ 2K	
☐ 5K	
☐ 10K	
☐ 20K	
☐ 50K	
☐ 100K	
☐ 200K	
☐ 500K	
☐ 1 Meg	

☐ **Model No. 53-2-1** — 5/16" cube, single-turn, screw-adjust, front, ½ watt 20%.

☐ **Model No. 41-2-1** — ½ x .3 x .160" rectangular, 15-turn, wedge-shaped pins, for easy pc work. ¾ watt 20%, screwdriver side.

☐ **Model No. 53-1-1** — .343 dia. x 5/16" high. Single-turn, 3-leads, screwdriver top. ½ watt. TO-5 transistor size, fits transistor sockets.

CALCULATOR CHIPS ON A "DIP"

Similar to Mostek 5001. Outperforms Texas 8-digit TMS1802. A 40-pin DIP. Adds, multiplies, subtracts, and divides. Use with 7-segment readouts, Nixies, and LED's.

- ☐ CT5001 12-digits 40-Pin ..... $6.50 3 for $18.
- ☐ CT5002-9 Volt version of 5001 — 8.50 3 for $24.
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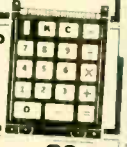

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☐ 3*	☐ CL†		
☐ 4*	☐ −†		
☐ 5*	☐ +, =†		
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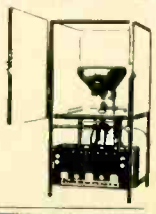

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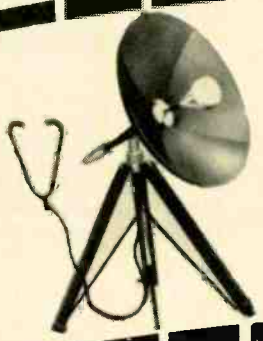

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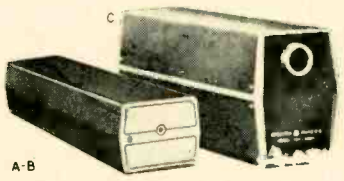

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The Technics SA-5400X. 4-amplifier 4-channel and 4-amplifier 2-channel.

Technics doesn't force you to choose between 2-channel and 4-channel. We give you both in one unit. The SA-5400X.

It's a very impressive 4-channel receiver. Each of its amplifiers delivers 8 watts RMS at 8Ω, all channels driven.* (4x8w = 32w.) And its full discrete capabilities include jacks for a CD-4 demodulator. Plus jacks for both 4-channel and 2-channel tape sources. And two tape monitor circuits.

There are also two matrix decoding circuits that can handle all the popular matrix methods.

The SA-5400X is a great 2-channel receiver, too. Because it has Balanced Transformerless (BTL) circuitry. Our special way of strapping the front and rear amplifiers in tandem for 4-amplifier 2-channel. Which more than doubles the power per channel in stereo. Producing 20 watts RMS per channel at 8Ω, all channels driven.* (2x20w = 40w.)

The amplifiers all have direct-coupled circuitry which vastly improves their low-frequency performance and power bandwidth. And a special phono-equalizer circuit so you can use virtually any kind of phono cartridge efficiently.

There's also a very potent FM section that boasts sensitivity of 2.0μv (IHF). With a 4-pole MOS FET and IF amplifiers whose ceramic filters yield 65dB selectivity.

We knew you'd have a hard time trying to make up your mind about which kind of receiver to buy. So we put both 2-channel and 4-channel in one easy-to-afford unit.

The SA-5400X. The concept is simple. The execution is precise. The performance is outstanding. The name is Technics.

*T.H.D.: less than 0.8%. Power Bandwidth: 7Hz—28kHz, -3dB.

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