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- CB radio alignment
- new CB designs

LEN FELDMAN EXAMINES NEW HI-FI CIRCUITS

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Stocking only 49 ECG™ semiconductors is like having thousands of audio transistors on hand.

Manufacturers of TV, radio and stereo systems have audio transistor replacements listed under thousands of different part numbers.

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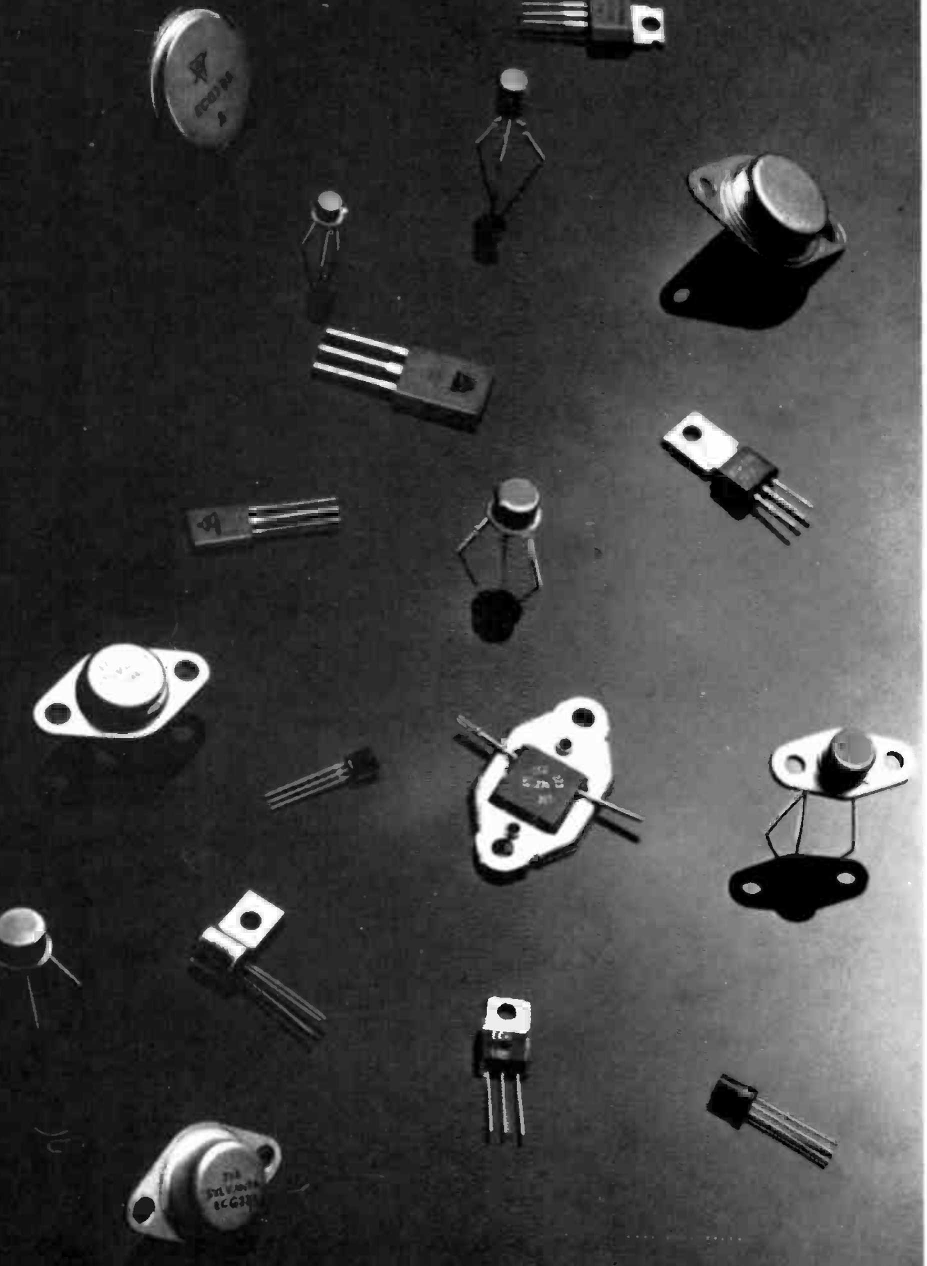

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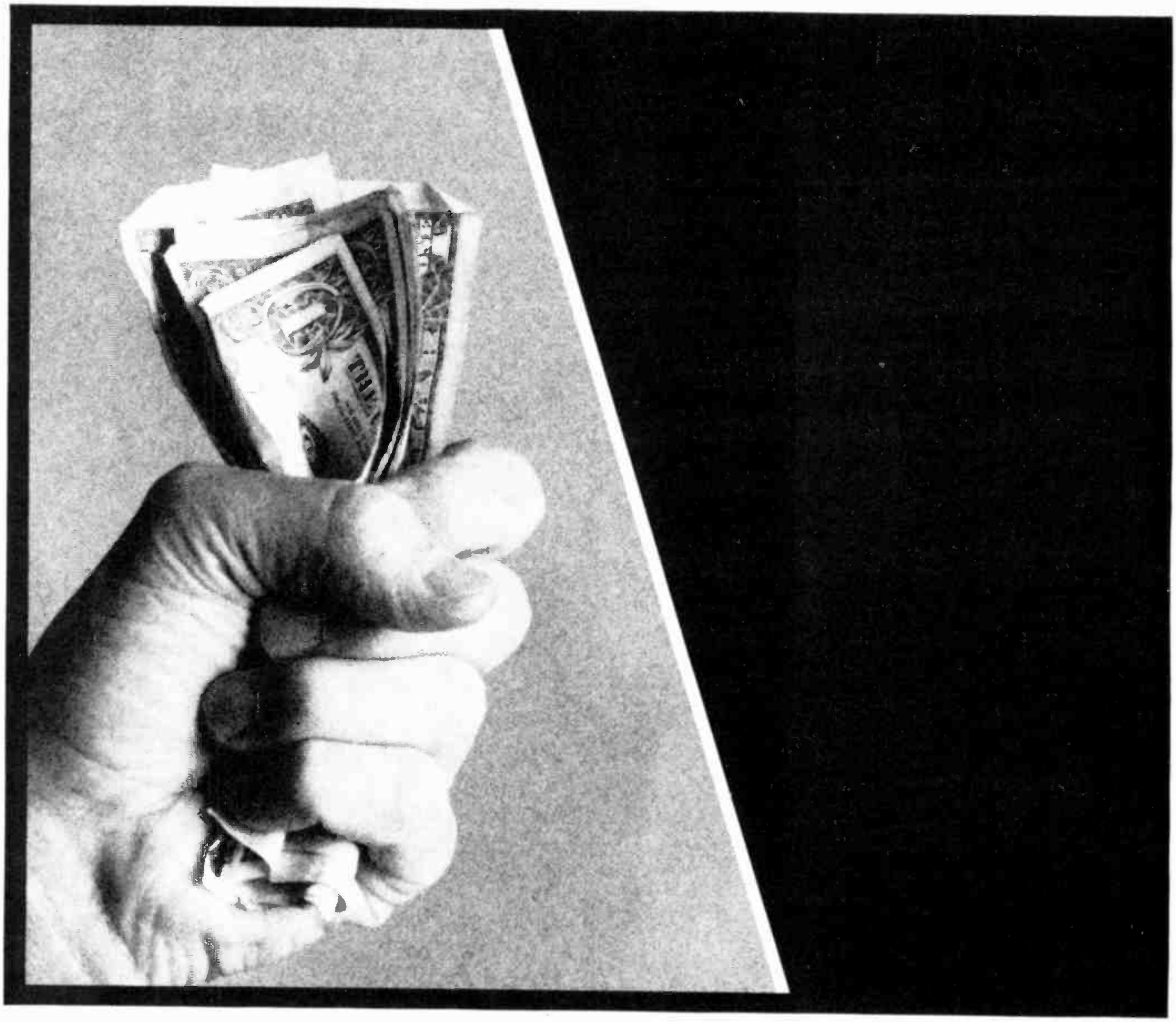

Radio-Electronics.

FOR MEN WITH IDEAS IN ELECTRONICS

More than 65 years of electronics publishing

JANUARY 1974

ON THE COVER

It's a cinch to take resistance readings with Hewlett-Packard's new digital multimeter. Here we are probing inside a Lafayette model 625 CB transceiver. For a full report on this unit turn to page 22.

NEW CB EQUIPMENT is full of the latest circuit features. Learn what they are and how they work.

... see page 36

Radio-Electronics is indexed in *Applied Science & Technology Index and Readers Guide to Periodical Literature.*

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looking ahead

Compatible videodisc?

Cannes, France — This month Telefunken begins marketing the world's first home videodisc system, as reported in this column in December. Telefunken's is a mechanical system, a "pressure stylus" reading out hill-and-dale impressions embossed on a flexible disc revolving at 1,500 rpm (for European color TV standards).

Several other firms—notably Philips of Holland and MCA Disco-Vision of Universal City, Calif.—have offered all-electronic approaches to videodiscs, using low-cost lasers to read out "pits" in a reflective disc. Although neither the Philips nor the MCA system is due on the market before mid-1975, their imminence has raised a question of standardization of home TV disc techniques.

Now along comes a major French firm which claims it has a laser-beam opto-electronic videodisc system which can play back its own discs and the Telefunken discs, and potentially any other disc which spins at a rate synchronous with the TV frame rate (1,500 rpm in Europe, 1,800 for the American and Japanese TV systems).

At the VIDCA videocassette-videodisc conference here, Thomson-CSF announced (but didn't demonstrate) the development of this compatible system, designed to retail at a price rivalling the Telefunken system's $450, and claimed it would play back 20- to 25-minute LP discs as well as Telefunken's 10-minute records.

The Thomson-CSF disc, as already reported here, is transparent, rather than reflective. A low-powered laser is beamed through the disc, and tiny "pits" in the flexible disc's surface refract the light. The refracted light is then translated into video and audio signals. The Thomson disc, like the Telefunken version, floats on an "air cushion," and Thomson engineers claim that this air-bearing effect makes unnecessary elaborate servo systems to keep the laser beam focused exactly on the pits pressed into the disc.

Thomson claims that its system can play back a Telefunken pressure-type disc, if the latter is pressed on transparent plastic. The laser beam is said to be able to read the hill-and-dale impressions on the Telefunken disc system as well as the pits on Thomson's own discs. Thomson officials also said they are working on techniques to play back Philips discs with their equipment. As are Philips, MCA and Telefunken, Thomson is currently wooing manufacturers in the United States, Japan and Europe.

One for the road

A unique highway radio system is now being phased into operation in Germany through the cooperation of the federal government, the state-operated radio systems and car radio manufacturers. The system, whose development is credited to Blaupunkt (Robert Bosch Co.), is designed to keep motorists fully informed of highway conditions, detours, traffic jams, etc. at all times, with a minimum effort on the part of the driver.

The system is being introduced in three phases, and depends on interaction between the broadcasting station and the car radio. Phase 1 is currently in operation: A regular FM station transmits highway information supplied by the police, auto clubs and other sources, along with its regular programming. In addition, it transmits a 57-kHz pilot signal. In Germany, 80% to 90% of auto radios have FM, and all car radios built in the last five years contain tape jacks. Radio manufacturers are offering (at about $20) an adaptor which plugs into the tape jack.

A light on the adaptor, activated by the pilot signal, indicates when the highway information is on the air. A special pushbutton mutes all stations not carrying the road information, so that the information channel may be easily found. A second version, for signal-seeking radios, automatically tunes to the highway station when the pushbutton is pressed.

All of West Germany eventually will be divided into seven sectors for highway information. Phase 2 of the program, currently being tested, permits the motorist to select the highway-information station from a neighboring sector, to get a preview of road conditions ahead, or to determine whether to move to the adjoining sector for better driving.

Phase 3 is aimed at people who don't like to drive with music. It will permit the motorist to tune to the highway information station, push a button and enjoy silence—muting all programming except road condition bulletins.

Satellite broadcasting

New Delhi, India—India is currently preparing for the first regular system of direct satellite-to-TV-set broadcasting. Scheduled to start in June 1975, the system will be designed to bring educational broadcasts to remote villages which can't be reached by conventional TV. The satellite, to be launched by NASA, will first be tested over the Rocky Mountain states, then moved to a synchronous position over India. An Indian government-controlled factory is already preparing to manufacture ruggedized solid-state receivers designed to be powered by 12-volt storage batteries—since many of the villages have no electricity. Each receiver will be fitted with a special front-end adaptor tuned to the satellite's frequency and a portable parabolic antenna. The receiver-antenna system will cost less than $400 to produce.

The receiver installations will be located in school and other public places, to carry school, agricultural and public health information. Although the test satellite will be stationed above India for only one year, the Indian government already has plans to build its own synchronous satellite for 1976 launching by "a friendly country," to continue the program.

Super-8 TV

Another delay in do-it-yourself video: Eastman Kodak's introduction of a super-8 vision-and-sound cartridge film attachment for home color sets has been postponed until spring. Initially, it was to have been introduced at the end of 1973. The Kodak unit is only one of three systems which permit hobbyists—or professionals—to display their super-8 films on conventional TV screens. The first to reach the market is being built in Japan by Fuji Film. In Germany, television manufacturer NordMende is aiming at marketing next May of its own system. None of the systems are compatible because they use different types of super-8 film cartridges—a Kodak cartridge for the Kodak unit, Fairchild cartridge for NordMende, special Fuji cartridge for Fuji's unit (although an adapter permits the showing of open-reel super-8 on the latter). All three systems are designed to accommodate film made with magnetic soundtracks.

by DAVID LACHENBRUCH
CONTRIBUTING EDITOR

new & timely

New pacemaker battery will run for 10 years

A new chemical (sodium-bromine) cell with an estimated life five times that of the mercury-zinc batteries now used in pacemakers is now undergoing tests in General Electric's Medical Systems Business Division, Milwaukee. The new battery is only half the size and quarter the weight of the mercury-zinc cells now used, and its voltage (3.6) is nearly three times that of the mercury cell. It can store 170 watt-hours of energy per pound, or 15 watt-hours per cubic inch, as compared to the mercury-zinc's 50 watt-hours per pound, or 8 watt-hours per cubic inch.

NEW BATTERY WILL LAST TEN YEARS. Designed for use as an implanted battery for pacemakers (devices that keep the heart beating in correct time) it will last five times as long as conventional pacemaker batteries, which have to be replaced by surgery every two years.

The new discovery established the chemical cell as the ultimate answer to the problem of powering pacemakers, believes Dr. Arthur Bueche, GE's vice president for research, and as superior to nuclear power sources or other proposed means of powering the devices. "The new long-life electrochemical power source," he pointed out, "would completely eliminate any hazard with the radioactivity of nuclear batteries and would greatly extend the intervals between replacement surgery for users of chemically powered pacemakers." In addition, the price of pacemakers powered with the new battery is expected to be a fraction of the cost of nuclear pacemakers (now estimated to be about $4,800).

The cell has a bromine cathode, a sodium-amalgam anode and a beta alumina ceramic electrolyte. Sodium ions travel through the ceramic electrolyte and react with the bromine, forming sodium bromide salt. The ceramic electrolyte prevents contact between reactive materials, eliminating the self-discharge and cell shorting that reduces the life of batteries that have a liquid electrolyte. Shelf life is virtually unlimited. Size of the unit is 1¼ inches in diameter by ⅜ inch high. It weighs about one ounce.

Avery Fisher gives $8-million to Philharmonic Hall

High-fidelity enthusiast and manufacturer Avery Fisher has made a donation estimated to be between $8 and $10 million to Philharmonic Hall of New York's Lincoln Center for the Performing Arts. Philharmonic Hall was immediately renamed Avery Fisher Hall.

Unlike many such large donations, which are often tagged for new buildings or ambitious projects, eighty per cent of the donation will be used for the running expenses of Philharmonic Hall, which up to the present have exceeded receipts by about half a million dollars a year. Twenty per cent of the grant will be devoted to a fellowship program designed to encourage and develop the careers of young American instrumentalists.

Mr. Fisher, himself an amateur violinist and a professional and amateur book designer and typographer, started his high-fidelity business in 1937, after a period of home construction of high-quality audio equipment for friends. Interestingly, the new venture was at first called Philharmonic Radio. Later, the name Fisher was adopted and became synonymous to knowledgeable audiophiles with the best in audio equipment.

In 1971, Mr. Fisher sold his Fisher Radio Co. to the Emerson Electric Co of St. Louis for about $30 million. "From that point on," he says, "I began to think about what I would want to do with such assets, far beyond the needs of myself and my family." Realizing that he "owed it all to live music and live musicians," he decided on the gift, which some believe to be the largest ever made in the United States "for direct operation of a theater, rather than for bricks and mortar."

Four winners of the 1973 Gernsback Scholarship Award

Grantham School of Engineering has selected Carl C. Dick for the 1973 Hugo Gernsback Award which is given annually to an outstanding student in each of nine electronics home-study schools.

Mr. Dick's first contact with electronics was through the RCA Tube Manual in 1950. Reading the principles of radio there sparked his interest in electronics. In 1957, he opened his own parts-sales and service business. Today, he is the sole in-warranty service dealer of RCA and Zenith in the Republic of Panama, besides accepting work on any make or type of electronic equipment.

In addition to all this, he finds time to study the Grantham course, direct the choir at church and enjoys his hobby of deep-sea fishing.

NRI's candidate for the 1973 Hugo Gernsback Scholarship Award, a $125 grant, is Hennen J. Blanton, Leavenworth, Kan.

Blanton's case tends to be unique, in that he is an inmate in a penal institution. Born in 1933 in Pittsburgh, Pa., he lost both parents at an early age, and led a somewhat nomadic existence. First involvement with the law was at age 11.

Previous to his present incarceration, he was variously employed as a vacuum cleaner technician, motor rewinder, maintenance electrician and computer operator. He became interested in education while in prison, completed his G.E.D. tests and received a high school equivalency diploma. He registered for NRI training because, as he says, "I have had a number of jobs and almost all of them required more knowledge than I had. I want to get training in various fields so that I will have more to offer than an untrained or partially trained person."

He worked in Federal Prisons Industries to obtain money to finance his studies. At present enrolled in the Electronics Technology course, he plans to enroll in an additional NRI course as soon as he completes the present one. The Gernsback Award, he says, will definitely benefit him in the pursuit of his goals, and he hopes that his newly acquired skills will enable him to "make it" on his release in 1977 or on parole in 1974.

(continued on page 12)

NOW you can train at home building a NEW 25" DIAGONAL Solid State Color TV engineered by NRI for learning and trouble-shooting

So much better for learning TV servicing than any hobby kit, because NRI designed and created it as an educational tool.

Unlike hobby kits which are designed for creating a TV set as the end product, NRI built its exclusive 25" Diagonal Solid State Color TV kit as a real training kit. You can introduce and correct defects . . . for trouble-shooting and hands-on experience in circuitry and servicing. The kits include a wide-band oscilloscope, color bar crosshatch generator, transistorized volt-ohmmeter and other valuable equipment that can soon have you earning $5 to $7 an hour servicing color sets in your spare time.

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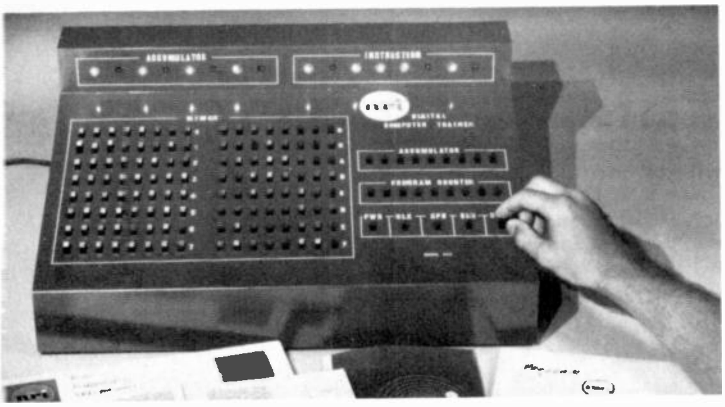
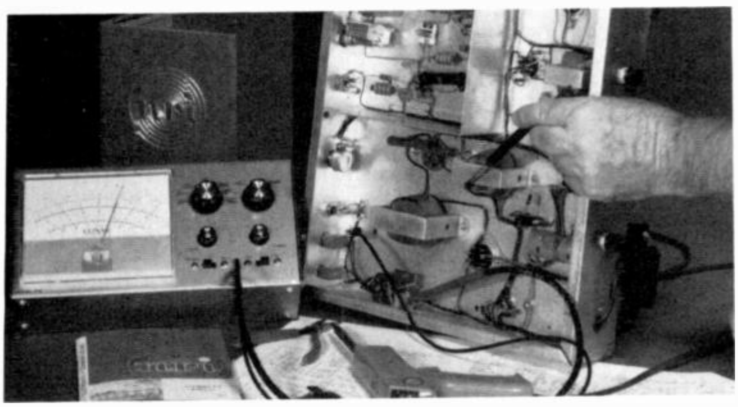
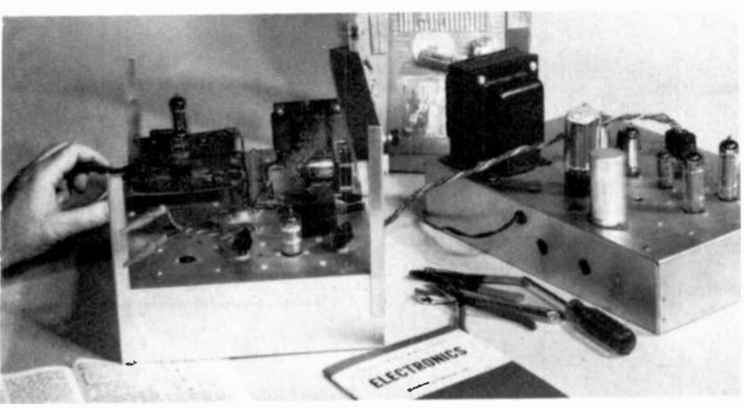


FIRST to give you a complete programmable digital computer, with memory, you build yourself... to learn organization, operation, trouble-shooting and programming. This remarkable computer is one of ten training kits you receive with the new NRI Complete Computer Electronics Course.



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 15-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.

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new & timely

(continued from page 12)

The winner from CREI is Fred Reynolds, Jr., now with the U.S. Navy.

He received his CREI diploma, and is now continuing with a course in Complete Communications, preparatory to sitting for his First Class Radio Telephone license examination. He has also been attending—under Navy orders—the Satel-

lite Communications School in Washington, DC, during the winter.

Vincent Lozupone, Brooklyn, NY, who has just completed the International Correspondence Schools Television Service Technician program, under the GI Bill, was unemployed when he enrolled in the course in March, 1972. He is one of the 1973 winners of the Hugo Gernsback Scholarship awards. He writes: "I'm 23

years old, and now working for Tele-Prompter, the largest cable corporation in the nation, as a CATV installer. Graduating from high school with no special interests, I worked as a clerk for two years. Then I was drafted. In the Army I became a radio teletype operator.

When I was discharged I decided to go to school for radio and TV repair. I took the ICS course. **R-E**

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SOLID-STATE IGNITION—NEW FOR LAWNMOWERS

by JACK DARR
SERVICE EDITOR

EVERYTHING'S "GOING SOLID-STATE" now—even the lawnmower! This also includes snowmobiles, small garden tractors, and outboard motors—anything powered by small gasoline engines. For a typical example, here's the system used in the Lawn-Boy mowers, in their 1973 line. It is actually a capacitor-discharge ignition system, "self-powered" in the same way as the old magneto systems. There are no moving parts in the system itself; no breaker points, no "condenser", etc.

Fig. 1 is a schematic diagram of the whole system. Three coils are used. One is the "charging coil" (2), another the "trigger coil" (5), and the last, the "spark coil" (7), which is the same as that used on automobiles. Output of this system is up around 30,000 volts.

All coils are energized by a magnet built into the rim of the flywheel. As the flywheel turns, the magnet moves past the laminated cores of the coils. (We're going to do something else with that spark coil in just a moment.) Fig. 2 shows how the unit and magnet are mounted.

Here is the sequence of events which happen as the flywheel turns. When the magnet passes the charge-coil laminations, it induces a voltage in that coil. This is true ac, since the magnetic field is built up, then collapses to make the current reverse. The ac voltage is fed to a diode rectifier (3), converted to dc, and then fed to the capacitor (4) to charge it to about 300 volts.

The other plate of the capacitor is connected to the anode of the silicon controlled rectifier (6). The SCR cathode is connected to the primary winding of the spark coil, (7). The SCR's gate is connected to the trigger coil (5). When the magnet passes the trigger-coil lamination, it generates a small voltage, only 1 volt or so. This gates the SCR on, and the capacitor is discharged through the spark coil. The

(continued on page 75)

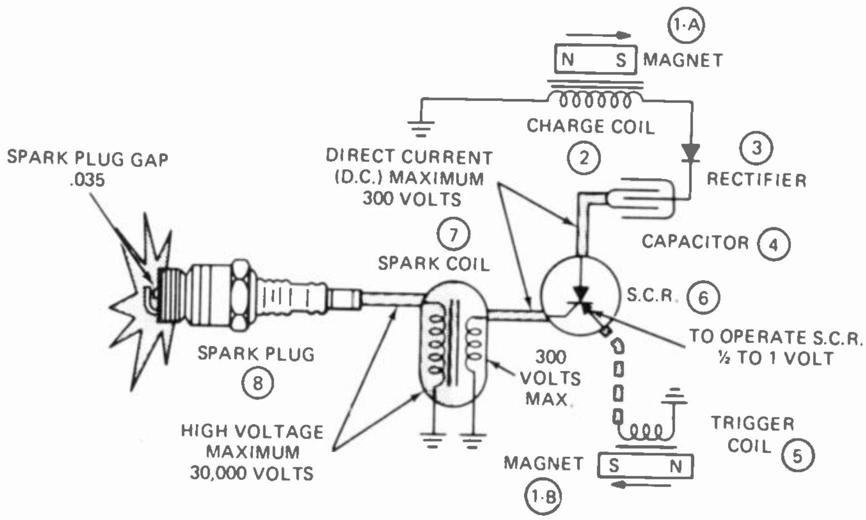


FIG. 1—COMPONENTS OF THE SOLID STATE UNIT. Numbers are explained in text.

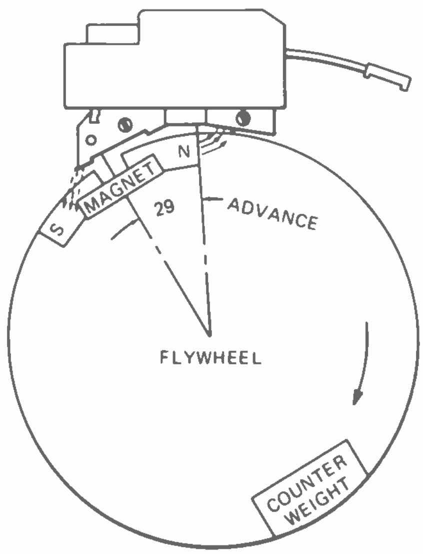
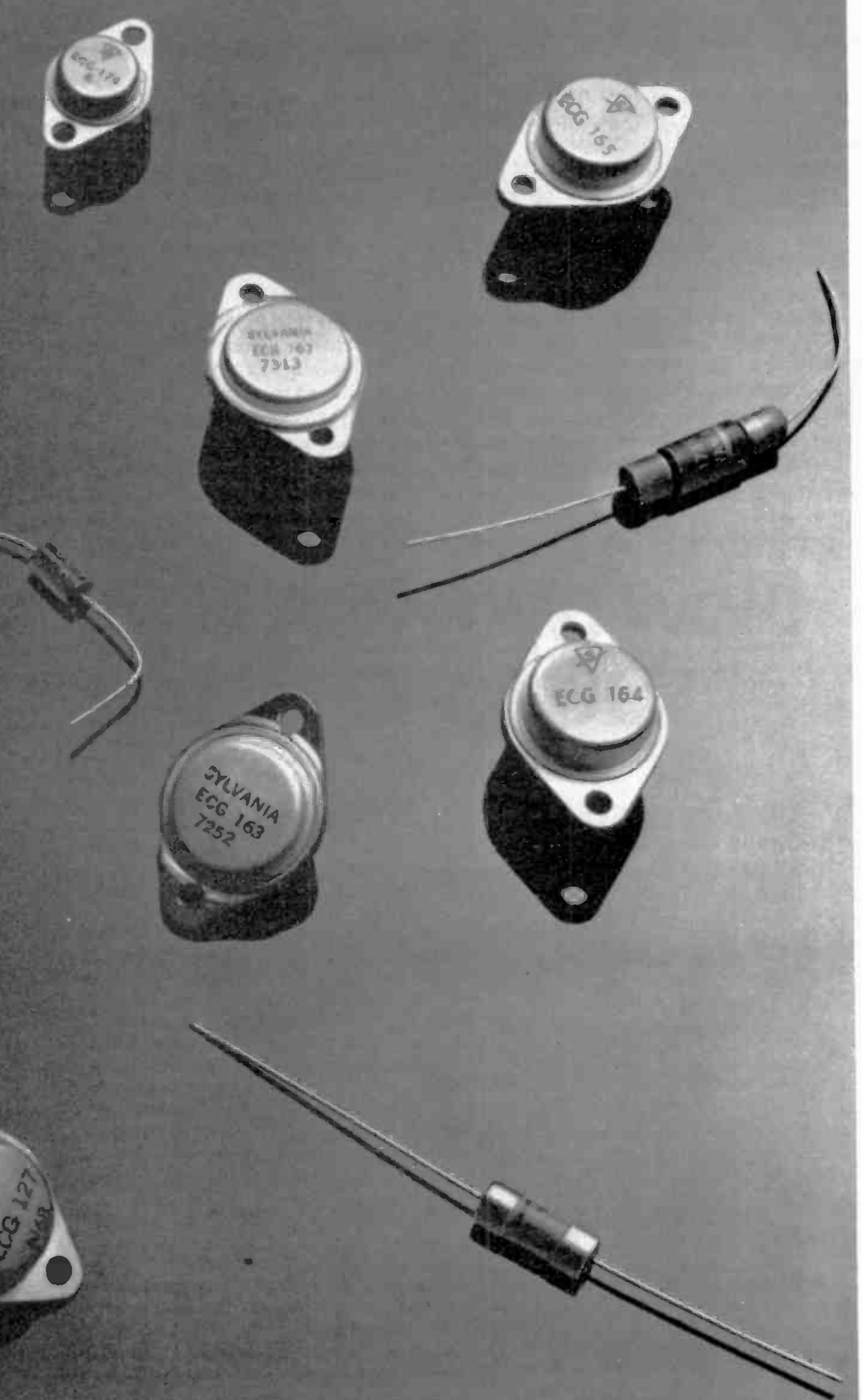


FIG. 2—MECHANICAL DETAIL, showing how magnet advances spark with increasing speed.

Stocking these 9 ECG™ semiconductors is like having hundreds of solid-state deflection circuit devices on hand.



GTE Sylvania has checked out hundreds of different TV set models to find out what they have in common.

And we've been able to boil down practically all of their deflection circuit needs to just nine parts.

Then, we put together a brand-new cross-reference guide (ECG-212E) that tells you which of the nine units replaces which numbers.

But, we didn't stop at deflection circuits. Our new guide also covers over 75,000 other parts including industrial components as well as all types of home and auto entertainment equipment.

Because we've reduced the number of parts that you have to have on hand, it's easier to keep a complete stock.

And that makes it easier for you to be sure you have the part you want when you want it.

GTE SYLVANIA

GTE Sylvania Electronic Components, Waltham, Mass. 02154.

letters

WARRANTY PROBLEMS

Just a few weeks ago a major tape recorder manufacturer more than doubled its warranty protection period. Recently I received the announcement of a major advertising campaign being launched by this same company. It's really wonderful—better equipment, purchasers protected by longer warranties, more advertising to sell more components. What is good for the high-fidelity industry is good for Eastern Stereo Servicenter . . . or, at least, that used to be our attitude.

But what about service for these growing quantities of all this wonderful new equipment? Equipment is becoming more complex with every new model introduced. First a channel was added to make stereo; now the industry is in the process of doubling the number of channels again, more than doubling our job of servicing. And with more complex technology involved—Dolby or other noise reduction systems, matrix or discrete demodulators—the investment in test equipment and people to use it is costly.

We independent service organizations are being expected to keep pace with changing technology and extended warranty periods without any increase in compensation. Getting good service on a piece of hi-fi gear is a problem that already exists in many areas. If manufacturers continue their present policies and attitudes, it will get much worse.

I wrote to the tape recorder company's president at the time his firm extended its warranty period, but didn't even receive the courtesy of a reply. Another manufacturer recently demonstrated its interest in its equipment purchasers being able to get qualified in-warranty service by reducing its labor rate. Getting parts orders filled within a reasonable amount of time and being supplied adequate servicing literature continues to be a major problem with a number of companies. (The customer blames us, not the manufacturer, for delays caused by this deficiency.)

The facts appear to be adding up to one thing. Too many manufacturers look at warranty service as being a necessary evil, responding principally to sales needs and governmental and consumerist demands. While it may not matter to the manufacturers, I don't believe that the industry as a whole can afford to lose the few good service facilities that do exist. If service were not important to dealers, why is it so many of them promote their service department (when most don't have even one qualified technicial or any good test gear) and extra long warranties?

We believe ours is a badly-needed commodity, with the need increasing as the industry continues to grow. If service truly is important, I challenge those concerned to place the service function on an equal level with manufacturing and sales, and begin giving it fair and honest treatment. Manufacturers . . . Industry . . . What is your response?

We at Eastern Stereo stand ready to participate with those interested in opening up a dialogue and serious discussion.

Marlin R. Taylor
Eastern Stereo Servicenter, Inc.
Upper Saddle River, N.J.

LEE de FOREST

This comes to you with heartfelt appreciation for the splendid article written in your magazine about Lee. And especially the part in regard to the serious wrong in comparing Lee's great invention—the vacuum tube—with the Fleming valve. The article also will be a great help to me in clarifying this wrong in my talks to organizations and to the school students.

The fine photograph of the two friends together brings back fond memories to me when I first met Mr. Gernsback on my first visit to New York from California over forty years ago as Lee's bride. Perhaps you have heard that a commemorative stamp was issued for Lee in New York on July 12, 1973.

Thank you again for everything. Thank you too for your kindness in sending me the extra copies of your magazine. They are being put to good use. One has been placed in the Electronics Museum to add to Lee's archives.

Maria de Forest
Hemet, Calif.

IT'S A TRADEMARK

We read the article "Secrets of Ion Plasma Tubes" by James A. Gupton which appeared in the September 1973 issue of **Radio-Electronics**. We note with interest that both Dr. Bennett and Mr. Gupton recognize that "Aquadag" is a standard and well-known product in the electronics field. However, we would like to point out to you that "aquadag" is a registered trademark of Acheson Industries, Inc., and when used should be properly referenced and identified as our trademark. We are confident that your misuse of "aquadag" trademark was purely unintentional and know that you will cooperate in helping us to protect this valuable name in future articles.

M. T. Musgrave
Port Huron, Michigan

NEW ASSOCIATION

The Amateur Television Association has been founded in 1967. It aims at promoting interest and stimulating experiments in the amateur video communication field.

The association is a purely non-profit one, organized by radio-amateurs and based on voluntary cooperation at the service of its members. It publishes a three-monthly, mainly technical magazine, entitled *ATA International*.

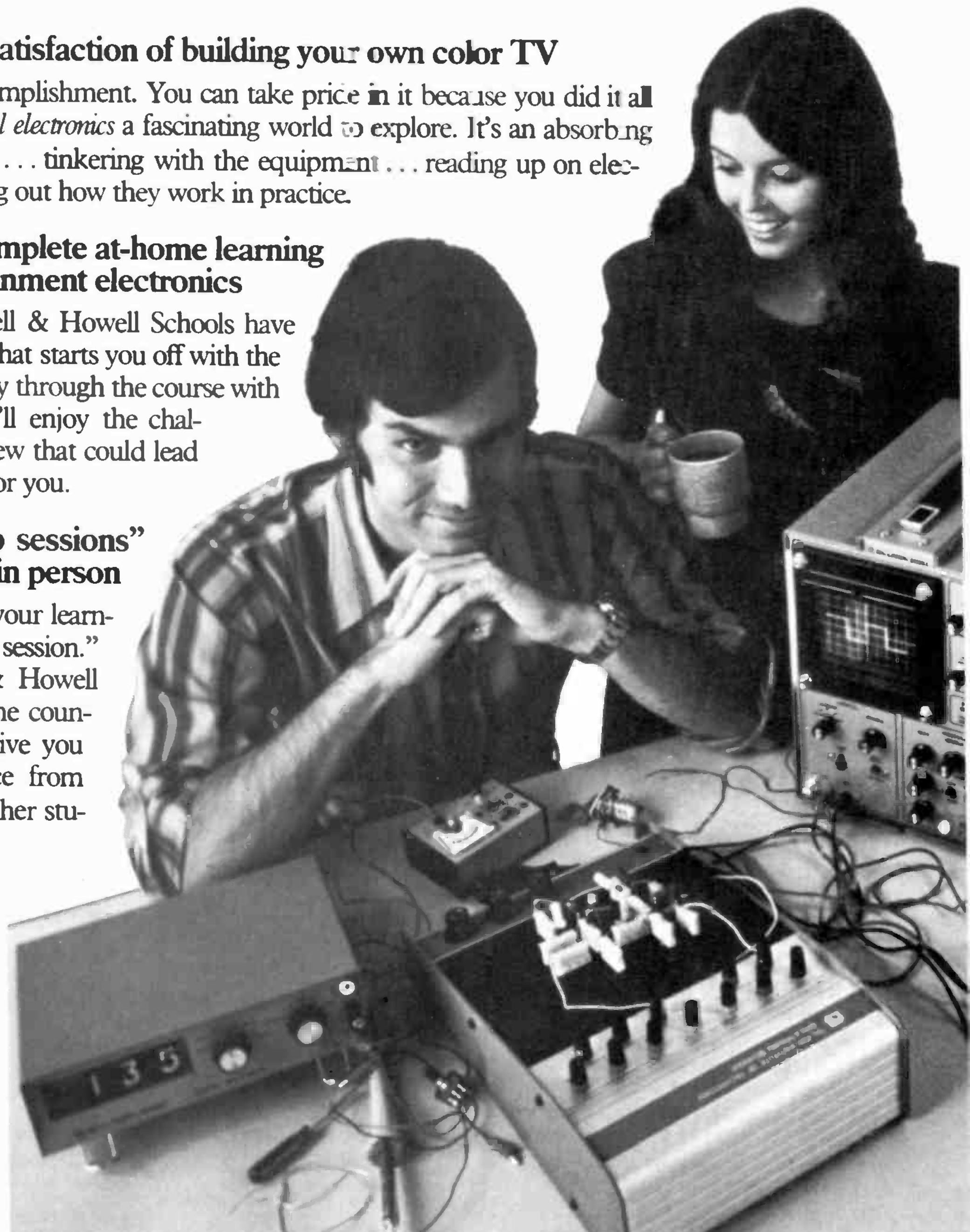
John Smet, ON5EX
Acacialaan 27
De Pinte, Belgium

Build your own Bell & Howell solid-state 25-inch diagonal color TV!

It's an enjoyable way to learn valuable skills in the exciting new field of *digital electronics* and also get a brand-new color TV you build yourself! For free information, mail the postage-free card today!

Enjoy the personal satisfaction of building your own color TV

It's not an ordinary accomplishment. You can take pride in it because you did it all yourself. And you'll find *digital electronics* a fascinating world to explore. It's an absorbing way to spend your spare time . . . tinkering with the equipment . . . reading up on electronic principles . . . and finding out how they work in practice.



Not just a kit—a complete at-home learning program in home entertainment electronics

Skilled instructors at Bell & Howell Schools have carefully prepared a program that starts you off with the basics and guides you smoothly through the course with step-by-step instructions. You'll enjoy the challenge of learning something new that could lead to extra income opportunities for you.

Attend special "help sessions" ... talk to your instructors in person

A unique advantage of your learn-at-home program is the "help session." Scheduled regularly at Bell & Howell Schools and in cities around the country, these informal seminars give you face-to-face, personal assistance from our instructors. You'll meet other students and enjoy talking shop.

Master the most up-to-date solid-state and digital technology

As color TV moves closer toward total solid-state, and as the more accurate and reliable digital systems begin to appear in home entertainment gear, you'll be thoroughly familiar with the most advanced troubleshooting techniques for these sophisticated circuits.

Digital electronics is growing everyday—and you can cash in on it!

Digital clocks and pocket calculators are already on the market. Soon, everything from speedometers to stereos to kitchen stoves will have digital readout and control systems in place of conventional dials and needles. During your program, you can gain the know-how to build, service or repair this new digital equipment, part-time or full-time!

You also build and keep the NEW Electro-Lab® electronics training system

Three professional instruments . . . a digital multimeter, design console and solid-state oscilloscope designed exclusively for Bell & Howell students . . . provide you with necessary practical experience during your program. It's the equipment you need to successfully analyze and master the principles of today's digital technology.

Earn extra income part-time or get ready for your own service business

We'd like to tell you more about this fascinating *digital electronics* program—and how it can lead to a promising future—full or part-time. Mail the attached card today and get all the facts.

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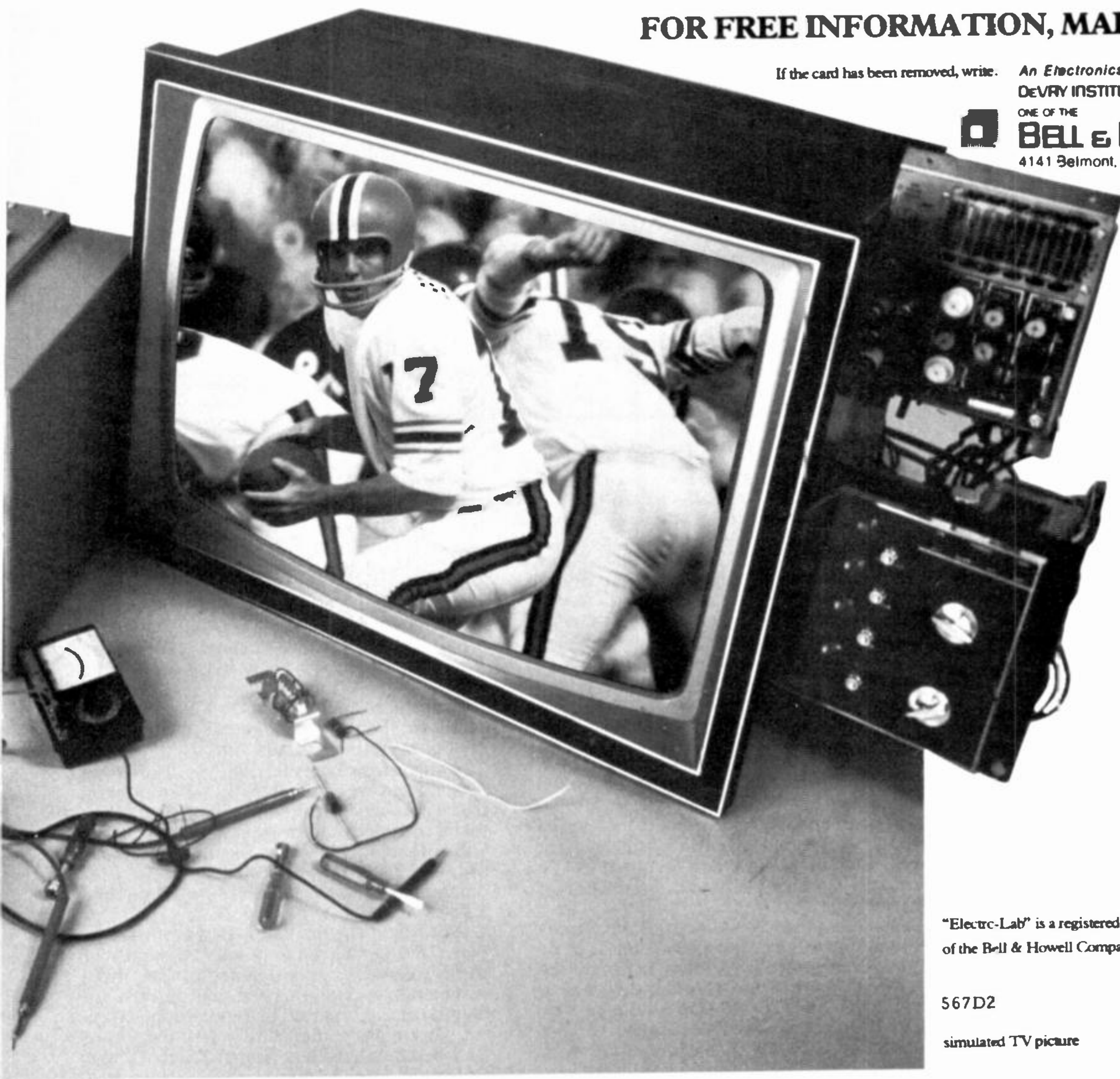
When you build your color TV, we include a complete volume on the "Guidelines For Starting Your Own Repair Business." It gives you all the basics including setting up shop, basic bookkeeping and income tax, small business legal requirements and customer relations. It's just another way we can help people get going in electronics.

FOR FREE INFORMATION, MAIL CARD TODAY!



If the card has been removed, write.

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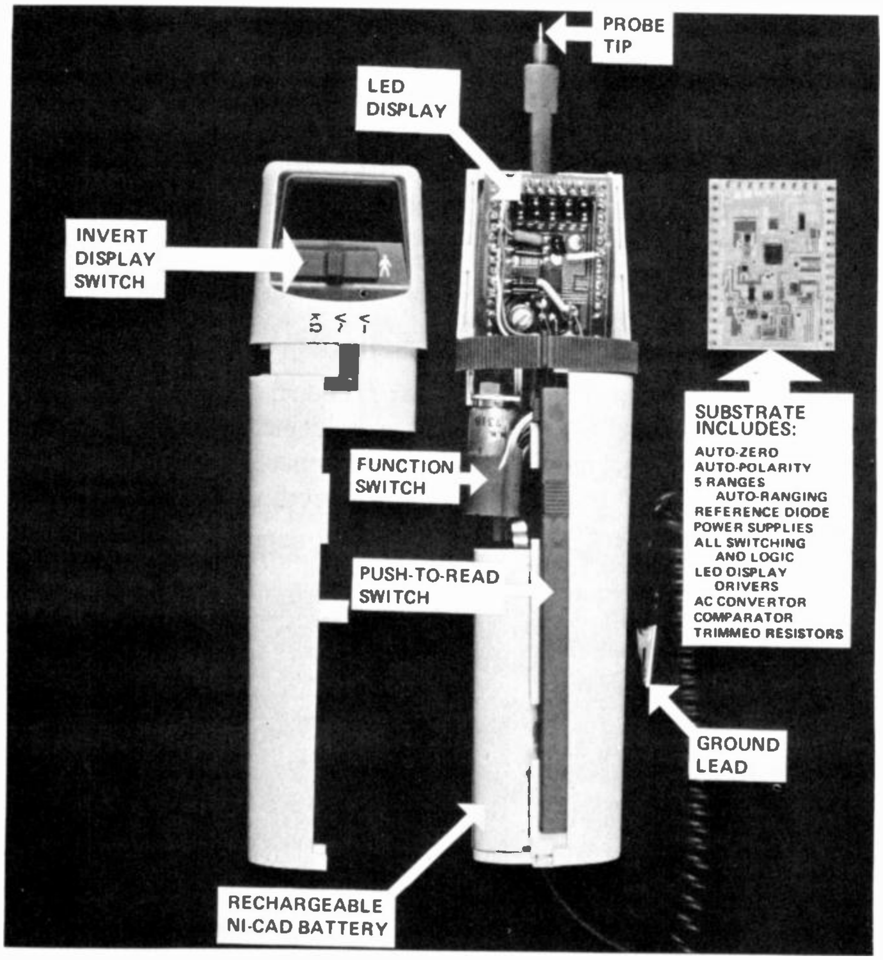
567D2

simulated TV picture

equipment report



I THOUGHT I'D LOST THE CAPACITY FOR being amazed, but I really haven't. They handed me a beautiful little soft leather pouch, about the size and shape of a big hot dog bun. "What's that?" "Oh, that's just a self-contained, automatic-ranging digital multimeter. It'll read ac or dc up to 500 volts, and resistance up to 10 megohms." "Oh, is that all? Hmm." Opening the zipper pouch, I found a device not as big as an electric toothbrush, with a coiled pigtail lead! (See this month's cover.)

It *was* a DVM, with all of the features mentioned above. This is the Hewlett-Packard HP-970A Probe Multimeter. It is, too—a "probe". A folding test prod on the business end can be set to several angles. To take a reading, just clip the pigtail lead to the low side or ground of any circuit, and use the instrument itself as the "test prod"! The readout is a 5-digit LED unit, on the end of the case.

A flexible plastic band around the case is the function switch. It can be set for ac or dc volts, or resistance (in kilohms). From then on, all you have to do is touch the prod to the circuit; the HP-970A does the rest by itself! Voltages read in five ranges: 0.1, 1.0, 10, 100 and 1000 (500 V maximum input, ac or dc).

The HP-970A is an "auto-ranging" type meter. Special circuitry adjusts the readout to whatever scale will display the reading best. Oddly enough, I used it for quite a while, taking several different voltage readings, before it dawned on me what this little thing was doing! It was setting itself to display the voltage, anywhere from about 0.5V up to about 250V. The decimal point moves, so that you always know what the reading is.

For resistance, the HP-970A reads in kilohms; thousands of ohms. For example, a 470-ohm resistor reads out as 00.470. A 2200-ohm resistor as 02.200, etc. For those times when we inadvertently do something that we know better than to do, a fuse resistor is included, in the ohmmeter circuit! It will withstand 115V rms for up to one minute, and 250V rms for 10 seconds. It is recommended that we take HP's word on this; I know I will!

Accuracy: the manual says 2% of reading plus 0.5% of the range in use. Accuracy of these tolerances is guaranteed, with measurements traceable to National Bureau Of Standards calibration. The input impedance is a very high 10 megohms on all ranges.

A separate Current-Shunt/Bench Cradle

(continued on page 81)

WHAT'S NEW in CB

Citizens band equipment has come a long way since the 27-MHz sector opened just over a decade ago. Here is a glance at what's available in transceivers and accessories.

by HERB FRIEDMAN

JUDGING BY THE AMOUNT OF NEW equipment coming out almost daily, the only things certain in life are death, taxes and the Citizens band. Never in the history of consumer electronics has there been such a diverse selection of equipment. As far as the CB user is concerned virtually anything desired in the way of features and/or performance can now be found in the CB marketplace. And it's a good safe bet that if you can dream up some feature not yet available some manufacturer will go all-out to incorporate that feature in his new equipment just as soon as he hears about it.

Fact is, there is so much differing CB gear available it's difficult to even start to describe the features available which could be of use to you or your customers. Perhaps the best way is to detail the features common to most, if not virtually all, CB transceivers and then break similar equipment down to common categories.

Features worth noting

Heading the list of common features is an external speaker (or remote speaker) output jack, previously common primarily to the full-feature transceivers only. Whether it's a need to get the signal over the ambient noise level by placing a speaker on the truck's dash directly in front of the driver, or a way to get the signal from the living room to a shop or backyard speaker, or just a quick and dirty way to connect headphones, all CB manufacturers have finally recognized the fact that an external speaker output is a *must have* and is not necessarily restricted to top-of-the-line transceivers. Now, even rock-bottom priced, limited-channel transceivers have this feature.

Another almost universal feature, found on mobile transceivers and some base station models is the PA (public adress) output jack, which permits the transceiver to be used as a public address system. Except for the very lowest priced models, this is also a common feature found in CB transceivers.

Metering is another biggie. Virtually all transceivers (except the budget models) have some sort of metering to show the relative signal strength of a received signal and the relative power output of the transmitter. In the high priced, or more deluxe transceivers—both AM and SSB models–there is likely to be more extensive metering including perhaps transmission (antenna) line SWR and perhaps relative or percent modulation. For example, some models from Browning, Dynascan, Midland, Pearce-Simpson, Regency, Robyn, Teaberry, and Tram have at least an SWR meter, while Browning and Dynascan also include a modulation meter in some models.

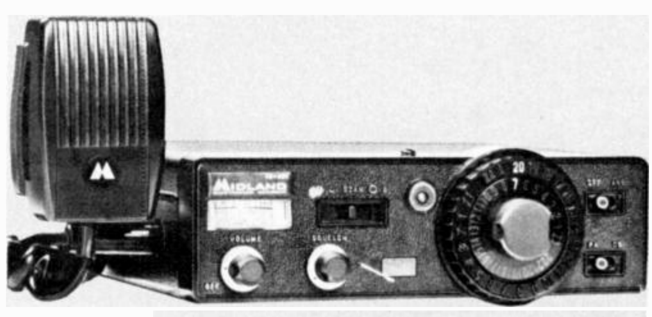
While everyone makes available a transceiver with full 23-channel coverage there are still many transceivers around which accommodate only 3 or perhaps 6 channels, for the user who has no need for full coverage. If you don't need full 23-channel coverage, you'll find a model in the lines from Dynascan, E.F. Johnson, Lafayette Radio, Midland, Pathcom (Pace), Pearce-Simpson, Realistic, Royce and Teaberry, just to name two handfuls. Actually, if you're not a CB hobbyist there's no real percentage in a full-23 rig as the extra, rarely used crystals can easily represent $50 or more in additional cost.

To meet the need of the CB user who must conceal his equipment, say in the

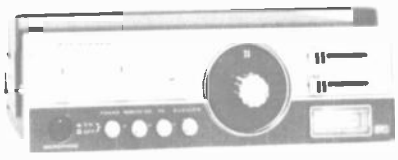
SKIPPER 73 is a hybrid rig from Palomar.

car's glove compartment, or who needs a rig that can be easily plugged in and set on the seat next to the driver, full 5-watt models have been shrunk down to the size of a child's walkie-talkie—the type sold for "Christmas presents". Some typical examples of the powerhouse handfuls are *Lafayette's*

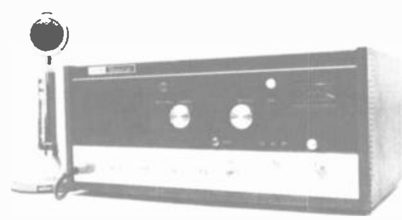
HY-GAIN 623 has features and looks of a ham-band transceiver.



MIDLAND MODEL 13-881 scans any two selected CB channels.



REALISTIC TRC-46, a top-notch mobile rig.



PEARCE-SIMPSON Lynx 23 base transceiver.

TRAM TITAN IV resembles hi-fi gear.

Micro 12 which measures in at about 1¾" × 5" × 7½", *Realistic's Mini-23* which shrinks a ruler to 1½" × 5¼" × 8" for full 23-channel coverage, *Teaberry's* really mini *MINI-T II* at 1⅜" × 4¾" × $6^{9}/_{32}$", and *Royce's model 1-590* which puts a full 5 watts into a jacket pocket. A feature of the Royce mini-mini sure to catch on is a plastic, rather than metal cabinet—which cuts the weight down almost to nothing. A camper can pack away a plastic-housed transceiver into his backpack and add virtually nothing in the way of extra weight.

Just as some transceivers have shrunk down to pocket size, the base-station models have grown larger and larger, jam-packed with features to spare. One particular feature coming into prominant use is the built-in digital clock such as used on some models by Dynascan, Courier, Fanon, Midland and others. In addition to indicating time, the clocks can be used to turn on the transceiver at a preset time to receive a scheduled "call". On the other hand, Browning and Tram use the giant size cabinets to house relatively large speakers, oversize easy-to-read meters and the extra controls needed for such things as microphone gain, SWR calibrate, etc.

Emergency services

With many CB'ers getting actively involved in volunteer rescue and emergency services it's only logical that they would have good reason and need to monitor the vhf public-service frequencies. While they can always use a separate vhf monitor radio, it is a convenience to have the vhf monitor built right into the CB transceiver. Presently, Courier and Lafayette have the only CB rigs with integral vhf monitors, but rumor has it at least two other manufacturers will soon have CB/vhf models.

And while we're on the subject of

COURIER REBEL 23 mobile transceiver.

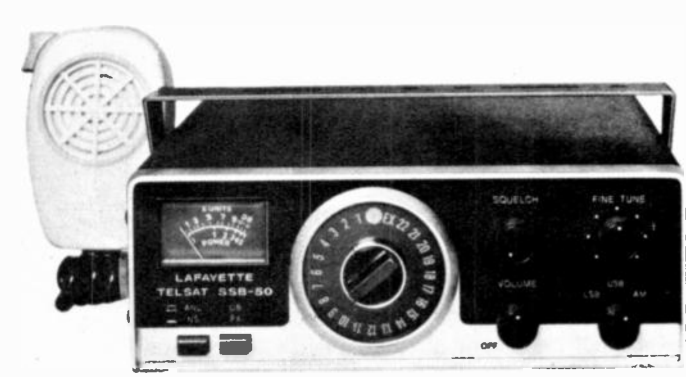
emergency services, let us not overlook the channel-9 emergency frequency. For REACT, ALERT and other "emergency CB groups" who provide full- or part-time monitoring of the national emergency channel, there are several transceivers with integral channel 9 monitoring. In almost all instances the channel-9 monitor consists of a fixed-frequency front end, i.f. amplifier and detector in addition to the regular CB receiver section. Even if the main receiver is tuned to a different channel, say channel 16, a signal appearing on channel 9 will cause some sort of panel indication, such as a lamp lighting, to indicate there's someone calling for HELP.

In some of the rigs with dual-receiver capability a signal on channel 9 will actually over-ride the main receiver reception, or the main reception will be interrupted and only channel 9 will be heard. Since the exact method of alerting the user to the presence of a channel 9 signal differs from model to model it's best to look for the exact type of operation desired: among the brands offering channel 9 or dual-receiver capability are Dynascan, E. F. Johnson, Lafayette and Realistic.

Unlike the conventional AM (amplitude modulation) CB transceivers which are available in everything from budget priced single-channel models from about $40—which feature just about enough circuitry and performance to get a message through if the CB band isn't jammed with stations, to high-performance models with performance levels matching the finest in equipment from any radio service, SSB (single sideband) CB transceivers have only one level of performance—as high as possible.

SSB rigs are available in mobile and base versions—the main difference being the power supply and perhaps a digital clock in the base models; otherwise, circuits and performance are essentially the same. All CB SSB rigs feature operation on both sidebands and AM, and if we'd look for one outstanding feature it would be super-selectivity for both the AM and SSB models. Either way, these are the rigs

TELEDYNE RA-510 has a push-button sensitivity selector switch.



TELSAT SSB-50, a 23-channel powerhouse from Lafayette.

that get the message through under the most severe interference conditions.

In addition to super-selectivity, a highlight feature of the SSB transceivers is a noise-blanker—a device that just about eliminates all impulse noise by literally punching a hole in the signal where a noise pulse should be—or would be even with an ordinary *noise limiter*. Though a few of the high performance AM transceivers feature a noise-blanker—generally in addition to a noise limiter for the "grinding" type of continuous noise, all SSB transceivers we have seen feature a noise-blanker.

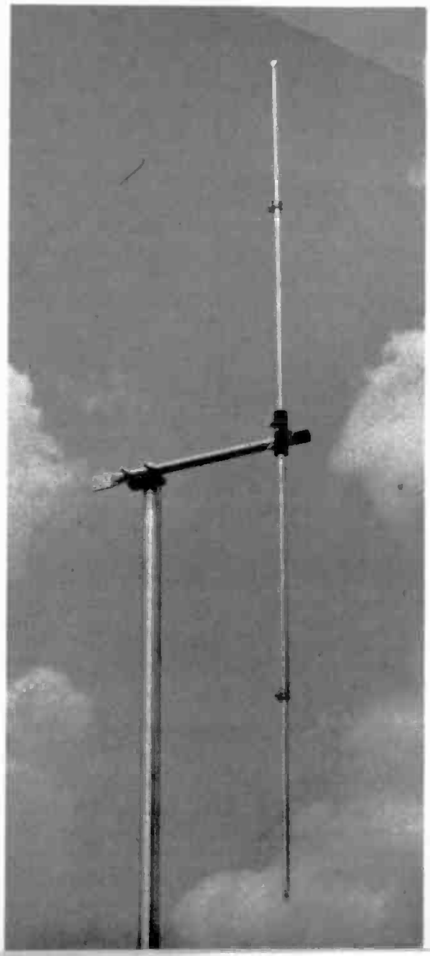
Almost all CB manufactuers now have at least one—generally more. SSB model in their line. Most all have essentially similar features and performance specifications, the major difference between models of the same family (mobile and base) being physical size, mounting convenience or power supply—some mobile models are negative ground only, some are negative or positive ground and some are 12Vdc/117Vac.

Walkie-talkies are still just walkie-talkies; everything from 100-mW "toys" to full-feature 5-watt models are available from endless sources under endless brands. The only thing that's really new are the full 23-channel models, which are basically high-performance 5-watt units packed into a walkie-talkie sized cabinet—generally

CUSH-CRAFT RINGO has 3.75 dB gain.

with a shoehorn. Using optional NiCad batteries, or a "penlight" battery pack, these units usually feature everything you'd find on a full-scale transceiver such as remote speaker output, external (12 Vdc) power supply, antenna jack, etc. So far, Lafayette and Realistic have had their full-23 walkie-talkies on the counters, with Midland, among others, announcing similar models at the time this is being written.

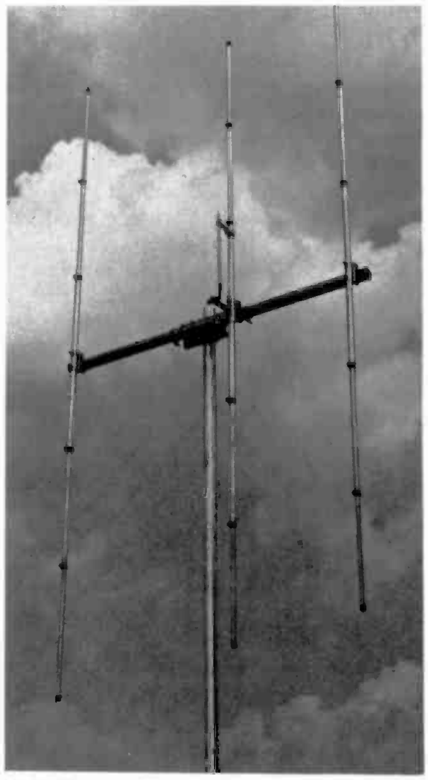
TS-1 CUSH-CRAFT 27–150-MHz dipole.



About antennas

Citizen band antennas come in every size and shape in almost every conceivable price range from a few dollars up. While there are still the old reliable ground planes, coaxial, and mobile whip antennas available, there are also highly directional models that look like they were used on the last moon shot—fact is, one model is called a "moonraker". As we move up the base station price range we find the antenna "gain" almost proportional to the price increase. For a few dollars more than the price of a basic groundplane there are "stretched groundplanes" with a few dB of extra gain—attained by beaming the energy usually radiated skyward down on the ground where it does some good. Add a few dollars more and we find 3-element beams such as used by the radio amateurs, only the CB beams are vertically oriented.

Keep moving up the price ladder and we get to 4-, 5-, and 6-element beams—each element (usually) adding a little more extra forward gain in a narrower forward radiation angle. Even the familiar "quad" (four-sided) element design of the radio amateurs has made its way into CB; and depending on how much you're willing to spend it's possible to get slightly more than 12-dB forward gain, which is like running almost



VERTICAL BEAM with 8 dB gain by Cush-Craft.

TURNER CB MIKE has a built-in preamp.

TRAM DIAMOND 60 has antenna protection.

80 watts into a standard groundplane antenna. At the receiving end the effect is almost the same as if the transmitter suddenly increased its power input almost 16 times.

Both standard and super-gain base station antennas are available—in a rather broad selection, under the old familar brands such as Antenna Specialists, Avanti, Cush-Craft, Hy-Gain, and Mosley.

Mobile antenna are available in every possible mounting system, from the standard body or bumper mount to magnetic and vacuum types which leave not a mark when they're removed. Among the manufactuers who offer a large variety of mobile antennas and mounting devices are Antenna Specialists, New-Tronics and Shakespear. Lafayette and Radio Shack (Realistic) have a large "house brand" assortment. Though the selection is not as great or varied as it is for automobile antennas, there are enough marine CB antennas to meet just about any type of mounting requirement.

TRANSCEIVER TESTER aids troubleshooting.

FANON T-1000, 23 channels, 5 watts.

Extras you might want

Gimmicks—*operating aids*, if you prefer, abound in CB. For those who need more microphone gain—perhaps to compensate for a low voice level—there are microphones with built-in amplifiers from Turner, who also produces an amplified model(s) with a built-in speech compressor for greater "average" modulation (talk power). For those who need only speech processing or compression without a new microphone there's equipment from Ascom and Gold Line, among others. Hy-Gain has a receiver preamplifier for souping the transceiver's sensitivity, while Johnson has a 6-Vdc convertor for powering "modern" 12 Vdc transceivers from 6-volt power sources. There are also antenna meters and antenna matching devices from Johnson; phone patches form Gold Line, Lafayette and Realistic (among many others); TVI (television interference) filters from Drake; and a super-deluxe base station control center with just about every conceivable station-accessory feature from Hy-Gain.

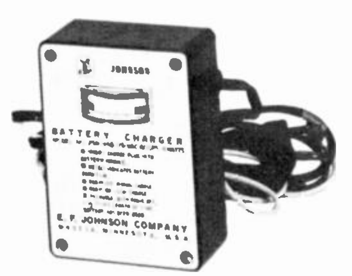
If you need a CB "station" tester for measuring SWR (standing wave ratio), power output and perhaps modulation the catalogs from Burstein-Applebee, Lafayette, Olson and Radio Shack list just about everything that's available, as well as most other CB "operating aids". Fact is, the best place to browse for most CB equipments are in these catalogs.

Summing up, we can safely state that except for photography no other hobby or interest has as great a selection of equipment and accessories. There is a transceiver, antenna, walkie-talkie and accessory to meet virtually every possible operating need. There is no CB idea so far out that some one hasn't already thought of it and manufactured the necessary equipment. R-E

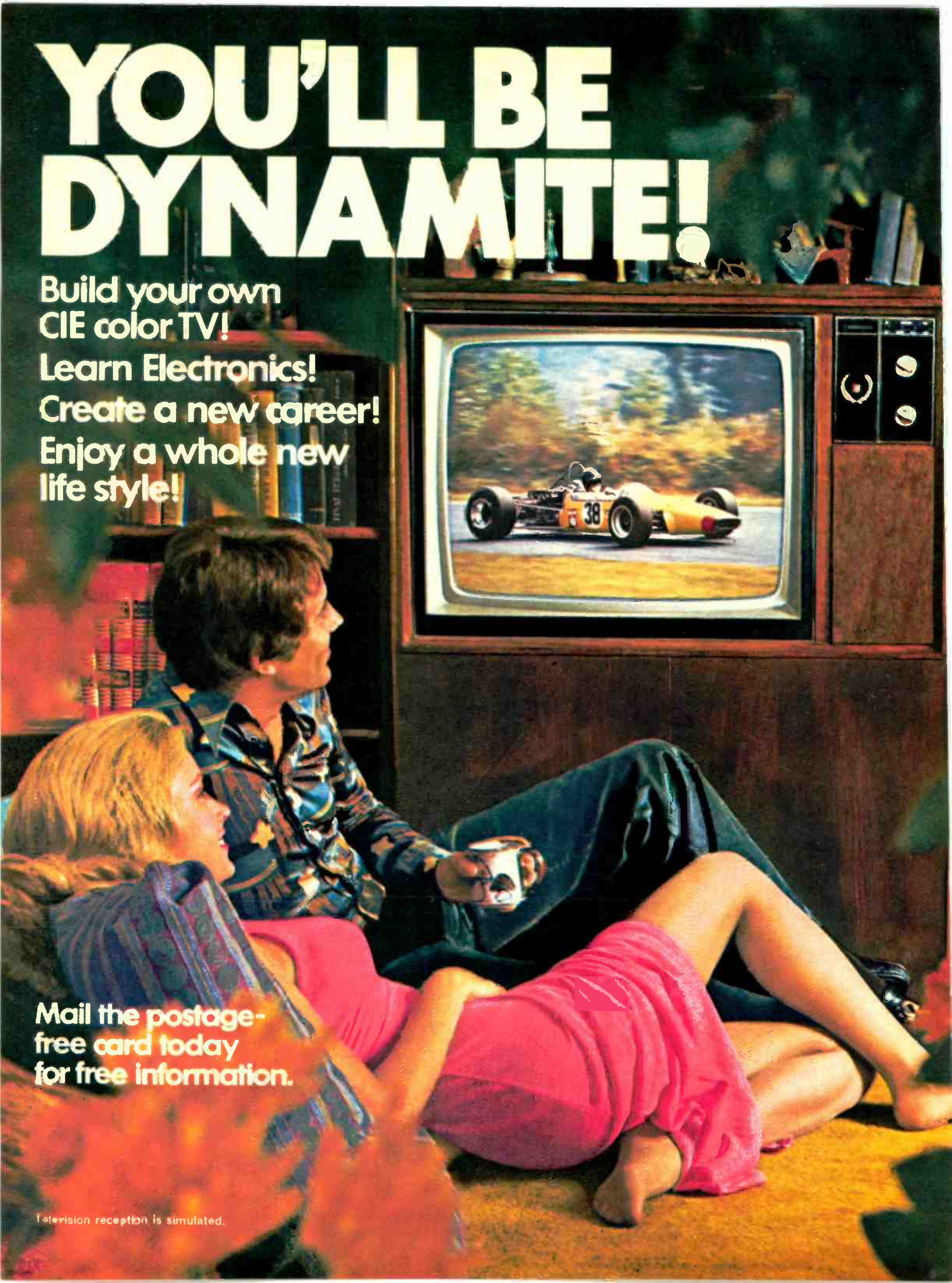
PEARCE-SIMPSON TIGER 23 is a mobile synthesizer rig.

MESSENGER 323-M is Johnson rig with dual receive capability.

PACE CB-9 is a mobile channel-9 monitor.



JOHNSON BATTERY CHARGER for NiCad's.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Television reception is simulated.

MODERN RECEIVER CIRCUITS

The communications superhet has made some startling strides during its 42 years of existence. Here's what its latest versions look like.

by RAY MOORE

THE SELF-CONTAINED, VERSATILE INSTRUMENT WE CALL THE communications receiver is becoming more complex these days. It has come a long way since James Lamb described the first one in *QST* in 1932. In his historic article Lamb defined the need for good selectivity and described the crystal filter to provide it. He also showed how to obtain the necessary oscillator stability to go along with high selectivity and he told how to tame an amplifier to get adequate sensitivity with the superheterodyne circuit. By 1934 and 1935 units which we would recognize today as communications recievers were on the market—National HRO, Hallicrafters Skyrider, Hammarlund Super-Pro.

The basic design described by Lamb remained the exclusive configuration until 1947 when Collins introduced the 75A. This receiver had a variable first i.f. and a constant tuning rate and set new standards for frequency stability and readout. The 75A was an amateur-bands-only design but was later followed by the general coverage 51J series. The variable first i.f. design is now used in most professional class communications receivers and many models in the low and medium price range.

In the early 1960's frequency synthesis techniques were used in communications receivers for the first time and the first all-solid-state receivers appeared on the market. Early in 1962 Davco announced the DR-30, a solid-state amateur receiver, and later in the year SBE introduced the SB-33, an amateur-band transceiver which contained a completely transistorized receiver. In 1964 National came out with the HRO-500 which was the first solid-state, general-coverage receiver. The same receiver incorporated a frequency synthesizer with a phase-locked oscillator to generate the 500 kHz, stepped injection frequencies for the first mixer.

Classes of communications receivers

Until the late 1940's all communications receivers were much the same. They varied only in the number of rf and i.f. stages used and in the quality of construction. They were general-purpose instruments and were sold largely to amateurs and SWL's, with some going to laboratory, commercial and military users. Point-to-point communications systems and others who needed more sophisticated and reliable equipment used custom-built receiving systems which often occupied several relay racks. Then, about 1949, the professional class of receiver appeared, a receiver priced beyond the mass amateur market and intended for military and commercial users who could afford the cost of the ultimate in stability and reliability. Some of the well-known receivers which appeared at that time were the Collins 51J, Hammarlund SP-600, and Hallicrafters SX-73. The difference between professional and general purpose receivers has continued to grow since then. Not many years ago a dual-diversity, independent sideband receiving system would have consisted of four separate receivers, combiners, oscillators and single sideband adaptors in several racks. Today such a system can be purchased in a single receiver cabinet.

Any attempt to classify communications receivers is bound to be arbitrary and subject to argument but the classifications that follow may be useful in picturing the wide variety we now have.

1. **Professional receivers** are priced from $2000 to $10,000 and are intended for communications circuits handling voice and data transmissions. Receivers in this class are invariably solid-state and cover the entire high-frequency range.

2. **Intermediate professional receivers** are found in the $800 to $2000 price range. They are general-coverage and solid-state. They are intended for the budget minded professional user and for the individual who can afford the best.

3. **General-purpose, medium-price** ($300 to $800) receivers are sold mainly to individuals, amateurs and short wave listeners. There are both specialized, amateur bands only, and general-coverage models. They may use vacuum tubes, transistors, or both.

4. **Low-priced receivers** (under $300) often provide a great deal of performance per dollar. Many of them tend to be quite similar to

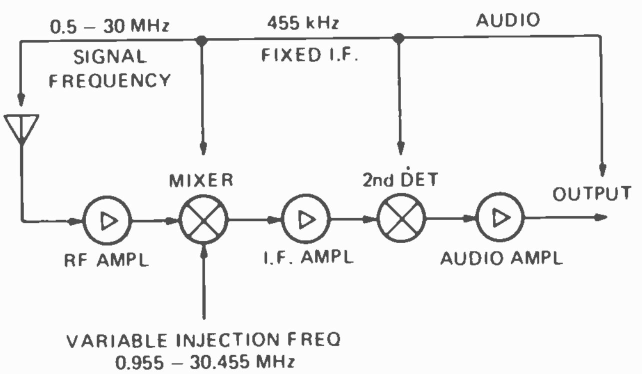


FIG. 1—BLOCK DIAGRAM of a conventional single-conversion superheterodyne receiver. Graphic symbols show each circuit function. The i.f. and audio amplifiers may each consist of one or several stages.

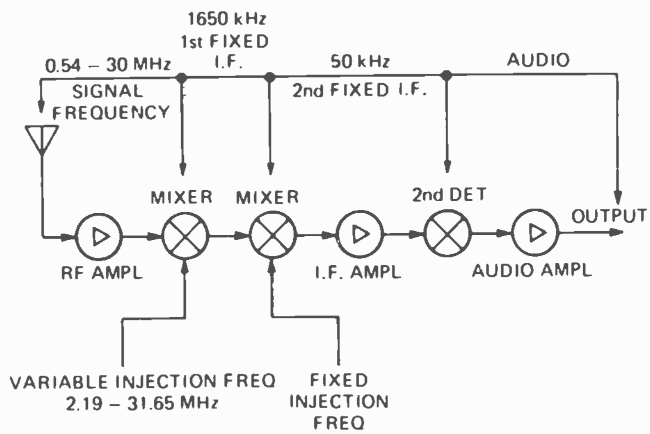


FIG. 2—A DOUBLE-CONVERSION SUPERHET. In this basic type, the first and second intermediate frequencies are fixed. The first i.f. may be passive or an amplified bandpass circuit.

medium-priced receivers with some relaxation in electrical and mechanical specifications. A large number are imported.

Basic receiver signal paths

A complete receiver is a system consisting of several distinct circuit groups:

1. Signal path circuits
2. Frequency determining circuits
3. Control circuits
4. Power circuits

We will discuss the first two of these in more detail in the balance of this article since it is in the signal path and frequency determining circuitry that modern receivers are most dramatically different.

The signal path describes the sequence of circuits through which the intelligence-carrying signal travels from the antenna input to the audio output of the receiver. There are really only two basic signal path configurations. The first intermediate frequency of a superheterodyne can be either *fixed* or *variable*. To look at it in another way, a variable oscillator can be used to beat with the different signal frequencies in the first mixer to produce a fixed i.f., or, a fixed frequency oscillator can feed the first mixer to produce a variable-frequency i.f. A fixed first-i.f. receiver can be either single or multiple conversion. The receiver with a variable first i.f. has at least two conversions.

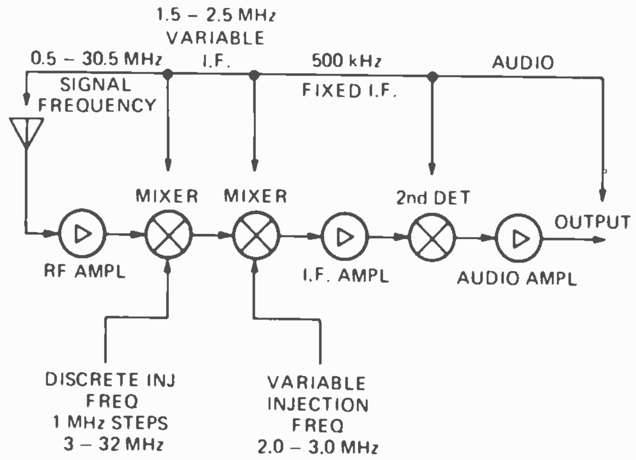
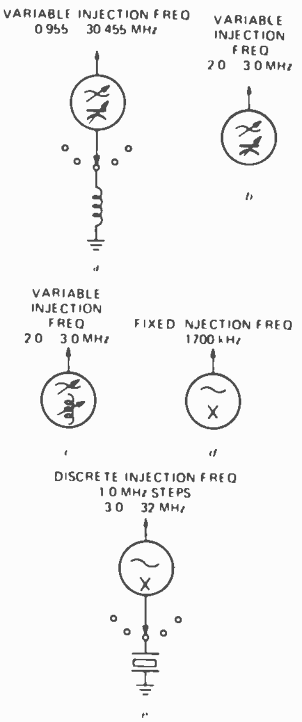


FIG. 3—THE FIRST I.F. IS VARIABLE in this dual-superhet. The first injection signal varies in 1-MHz steps so the tuning range can be covered in a number of bands, each 1 MHz wide. The second i.f. provides the selectivity and may include a crystal or mechanical filter.



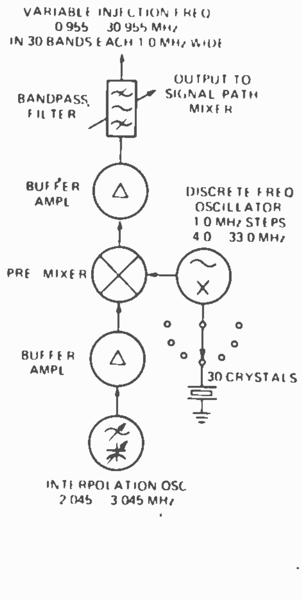


FIG. 4 (left)—GRAPHIC SYMBOLS representing different frequency-determining circuits.
FIG. 5 (right)—PRE-MIXER OR PARTIAL SYNTHESIS makes it possible to develop a single-conversion superhet with good stability, constant tuning range and precise calibration. Interpolation oscillator with range of 1 MHz (or 500kHz in some designs) develops a signal that is heterodyned against a crystal.

The fixed first i.f. was used by Lamb and by all commercial communications receivers until 1947. The incoming signal is converted to a fixed i.f. by a variable injection frequency in the mixer (see Fig. 1). The variable injection-frequency source, often from a simple tuned oscillator, must cover the entire frequency range of the receiver plus the value of the i.f. If a receiver has a fixed first i.f. at 455 kHz and tunes from 0.5 to 30 MHz, the injection frequency must cover the entire range from 0.955 to 30.455 MHz—usually in bands with a frequency tuning ratio of around 3:1.

Simplicity is a virtue in receiver design and for that reason the fixed first i.f., single-conversion receiver is attractive. However, as usually designed, the single-conversion receiver has two serious drawbacks when compared to modern receiver standards. First, the i.f. is a serious compromise between image rejection ratio which requires a high-frequency i.f. and adjacent-channel selectivity requiring a low-frequency i.f. Second, the local oscillator, which provides the mixer injection frequencies, covers such a wide range of frequencies that it is almost impossible to build it to conform to modern standards for stability, constant and linear tuning rate, and calibration accuracy. With the availability of high-frequency crystal lattice filters (and various types of mechanical filters) and pre-mixer and synthesizer frequency generation techniques, it is now possible to overcome the drawbacks, and we may soon see a trend back to the single-conversion receiver.

The variable first-i.f. configuration is used in almost all professional-type receivers and in many medium-priced receivers. The advantages, over ordinary fixed first-i.f. receivers, are a *constant tuning rate and calibration* on all ranges and much better stability. These advantages are possible because the variable injection-frequency source which feeds the second mixer covers only a single, small band of frequencies. The smaller the frequency range to be covered and the lower the frequency, the easier it is to build a stable and linear oscillator.

A typical variable first-i.f. receiver is shown in Fig. 3. The circuit after the first mixer consists of a conventional fixed first-i.f. receiver tuning from 1.5 to 2.5 MHz. The first mixer translates all incoming signals to the 1.5 to 2.5 MHz range by mixing them with a series of stepped injection frequencies spaced one MHz apart.

If you want to receive the 4.5 to 5.5-MHz band, for instance, a 7-MHz frequency is injected into the first mixer. A 5.5 MHz incoming signal beating with the 7-MHz injection frequency will produce a difference frequency of 1.5 MHz which falls within the range of the variable first i.f. A 4.5-MHz incoming signal will produce a difference frequency of 2.5 MHz (7 MHz – 4.5 MHz=2.5 MHz) which is at the other extreme of the variable i.f. range. Similarly, any other signal between 4.5 and 5.5 MHz will be converted to some frequency in the variable i.f. range. To tune signals in the 5.5 to 6.5 MHz range you inject an 8-MHz frequency into the first mixer, and so on in 1-MHz steps.

The signals from the variable i.f. go to the second mixer where they are mixed with a variable injection frequency covering 2.0 to 3.0 MHz and converted to the 500-kHz fixed i.f. The 5.5-MHz signal which was converted to 1.5 MHz (as just described) would be mixed with a 2.0 MHz injection frequency in the second mixer and converted to a frequency of 500 kHz. When the variable injection frequency is tuned to 3.0 MHz it will beat with a 2.5-MHz signal from the variable i.f. to form a 500-kHz signal. Thus, any signal between 1.5 and 2.5 MHz from the variable i.f. can be changed to 500 kHz by injecting the proper frequency in the range of 2.0 to 3.0 MHz.

The injection frequencies for the first mixer can be from a crystal oscillator (*translation oscillator*) with switchable crystals spaced 1 MHz apart. The variable injection frequencies for the second mixer can be from an oscillator which is sometimes called an *interpolation oscillator* from its function of filling in between the steps of the translation oscillator.

Frequency-determining circuits

The second important group of circuits in a receiver are the frequency-determining circuits. In Lamb's receiver the frequency-determining circuit was a single high-frequency oscillator. In a modern, professional type receiver the frequency-determining circuits may be more complex and contain more active devices than the signal path.

There are four types of injection frequencies required in the different receiver configurations.

1. Wide range, continuously variable frequencies for the first mixer of fixed first i.f. receivers (Figs. 1, 2).

2. Limited range, continuously variable frequencies for the second mixer of variable first-i.f. receivers (Fig. 3)

3. Fixed, single-frequency injection for the second mixer of fixed first-i.f. double-conversion receivers. (Fig. 2)

4. Discrete, stepped frequencies for the first mixer of variable first-i.f. receivers. The frequencies must be spaced by the width of the first i.f. (Fig. 3)

The four types of injection frequencies are usually supplied by simple oscillators in low and medium-priced receivers. Oscillators have the advantage of simplicity and low cost. They have two disadvantages which can sometimes justify the use of more complex circuits. First, some commercial applications require stability on the order of a few hertz per day. Limited-range variable oscillators used in commercial receivers have stability specifications ranging from 100 Hz per two hours to 30 Hz per day. Better stability than this requires the use of frequency synthesis techniques. Secondly, the discrete, stepped injection frequency for the first mixer of a variable first i.f. receiver must be crystal controlled if a simple oscillator is used. This is not a problem in an amateur-bands-only receiver which may have eight 500-kHz bands, but a general-coverage receiver covering 0.5 to 30 MHz in 500-steps kHz would require 59 crystals and a 59-position switch. There is also the problem of zeroing in each crystal to maintain calibration accuracy.

The different types of simple oscillators which can be used to provide injection frequencies are shown in Fig. 4. The continuously variable injection frequency requried by the first mixer of a fixed first-i.f. receiver can be supplied by a switched high-frequency oscillator (Fig. 4-a). The wide frequency range which this type of oscillator must cover is achieved by switching inductors which are tuned by a variable capacitor. The disadvantage of this type of oscillator is that there is a different tuning rate and calibration on each band—the tuning rate becomes faster and the calibration becomes more crowded as you go higher in frequency. Also, it is almost impossible to meet modern stability requirements with an oscillator covering such a wide frequency range. Top quality receivers using this type of oscillator have stability specifications of 300 to 3000 Hz per day at 30 MHz.

Limited-range variable-frequency oscillators can be either capacitively or inductively tuned (Figs. 4-b, 4-c). Their stability can be as good as 30 Hz per day because of their limited range and the relatively low frequency at which they operate. They can also be made quite linear so that a given frequency increment occupies the same space anywhere on the dial.

Only a single frequency is required for injection to the second mixer of a double conversion, fixed first-i.f. receiver and this can be supplied nicely by a crystal-controlled oscillator. (Fig. 4-d)

The discrete, stepped frequencies for the first mixer of a variable first i.f. receiver can also be derived from a crystal oscillator. (Fig. 4-e) Different crystals are switched in to change bands.

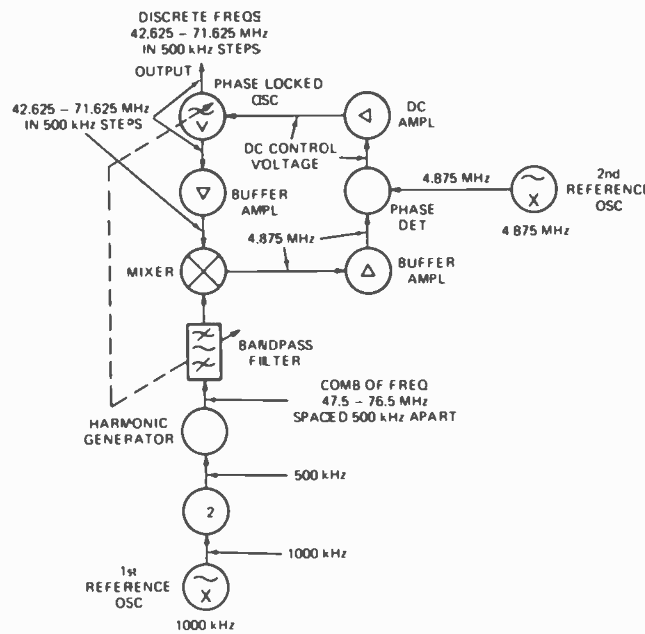
The pre-mixer technique of frequency generation makes possible a single-conversion, fixed first-i.f. receiver with the stability, constant tuning rate, and calibration accuracy of the variable first-i.f. receiver. The complexity removed from the signal path, however, is added to the frequency determining circuitry. Pre-mixing is a form of frequency synthesis since the final frequencies applied to the signal mixer are synthesized from other frequencies in a series of circuits (Fig. 5).

The outputs of a limited-range, variable-frequency oscillator and a crystal oscillator are both applied to a mixer. The difference between the two frequencies is then applied to the signal-path mixer through a buffer amplifier and filter. Crystals, 1.0 MHz apart, are switched in the crystal oscillator to change bands. The disadvantage of this technique for general-coverage work is the large number of frequencies put out by the pre-mixer—the interpolation oscillator frequency, the crystal oscillator frequency, the sum and difference frequencies, and higher order combinations of all these frequencies. All these unwanted frequencies can cause spurious responses if they get into the signal-path mixer. One solution is to put a tunable filter between the pre-mixer and signal-path mixer. Another is to use the output of the pre-mixer to control a phase-locked oscillator whose output is fed to the signal-path mixer.

A simplified block diagram of the frequency synthesizer used in the Galaxy R-530 receiver is shown in Fig. 6. The R-530 covers a frequency range of 0.5 to 30 MHz in 500 kHz wide bands with a variable first i.f. of 41.625 to 42.125 MHz. This conversion scheme requires a series of discrete frequencies every 500 kHz from 42.625 to 71.625 MHz for injection to the first mixer. These frequencies are provided by the frequency synthesizer to be described.

The actual frequency injected into the first mixer is generated by a tunable *phase-locked oscillator*. This oscillator is tuned manually by a variable capacitor and it can also be controlled electronically by a dc voltage applied to a varactor diode. The desired output of the phase-locked oscillator is any one of 59 discrete frequencies spaced 500 kHz apart from 42.625 to 71.625 MHz, the injection frequencies required by the first mixer. The oscillator will tune the entire range continuously but is *held in and locked* only at 500 kHz intervals by a series of control frequencies derived from the 1000-kHz reference oscillator, much as the local oscillator in an FM receiver is locked to the signal by the afc circuit.

The output of the crystal controlled 1000-kHz *reference oscillator 1* in Fig. 6 goes through a divide-by-two circuit to produce a



SYNTHESIZER CIRCUIT USED IN GALAXY R 530

FIG. 6—FREQUENCY SYNTHESIZER used in the Galaxy R-530 general-coverage receiver covers 500 kHz to 300MHz in 500kHz bands.

500-kHz frequency which is applied to a harmonic generator which produces what is called a *comb of* frequencies. A comb of frequencies is a series of uniformly spaced discrete frequencies spread simultaneously across a portion of the rf spectrum. The output of the crystal calibrator in a communications receiver can be considered a comb of frequencies spaced 100 kHz apart. The output of the harmonic generator in the R-530 is a comb of frequencies spaced 500 kHz apart between 47.5 and 76.5 MHz. The appropriate frequency from the comb is selected by the filter following the harmonic generator. The tuning of the filter is ganged with that of the phase-locked oscillator.

The frequency selected by the filter from the comb is used as a reference to which the phase-locked oscillator is locked and it is always 4.875 MHz higher than the desired output of the phase-locked oscillator. The selected reference frequency is combined with the output of the phase-locked oscillator in the mixer. The difference between the two frequencies is applied through a buffer amplifier to the phase detector.

The phase detector has two frequencies applied to it, the output of the mixer and the output of the 4.875-MHz crystal-controlled reference oscillator. If the outputs of the mixer and the second reference oscillator are exactly the same frequency there will be no dc output from the phase detector. If the two frequencies are *not* exactly the same the phase detector generates a control voltage which is applied to the phase-locked oscillator to pull it into tune. Of course, there is a limit to the range over which the phase-locked oscillator can be pulled. Auxiliary circuits actuate a panel light and audio tone which tells when the phase-locked oscillator is not locked. The procedure is to tune the phase-locked oscillator tuning control until the light and audio tone go off, indicating lock has been achieved.

The R-530 synthesizer, in summary, produces 59 discrete frequencies, one at a time, each one phase-locked to the reference crystal oscillators. Thus 59 crystal controlled injection frequencies are generated with only two crystals and no switches. **R-E**

NEW CB Circuits

Some CB transceivers are as sophisticated as some of the more advanced gear used by hams and other 2-way operators. Here are details on circuits in 1974 rigs.

by ROBERT F. SCOTT
TECHNICAL EDITOR

SINCE THE 11-METER (27 MHZ) BAND WAS assigned for Citizens band service early in 1959, the equipment has evolved from superregenerative receivers and modulated-oscillator transmitters to solid-state complexities operating in both AM and single sideband modes and featuring such goodies as 23-channel frequency synthesis, razor- sharp selectivity, and automatic noise limiters and blankers. This aricle describes some of the circuit features in the latest CB gear.

First, we'll take a look at the block diagram (Fig.1) of the Lafayette Micro 923, one of the more sophisticated transceivers that has frequency synthesis, Range Boost and a separate built-in monitor for channel 9.

Frequency synthesis is a system that provides crystal-controlled transmission and reception on 23 channels while using only about one-fourth of the 46 crystals required without frequency synthesis. In the diagram, we have a total of 14 crystals in the synthesizer. The 33-MHz oscillator uses one of the six crystals 50 kHz apart between 33.000 and 33.250 MHz. When transmitting, one of the 33-MHz crystals is selected and its signal heterodyned against a 6-MHz (6.035, 6.025, 6.015, 5.995 MHz) crystal producing a difference frequency equal to the precise frequency of the desired CB channel.

The receiver circuit is a double-conversion superhet with a 5.995–6.035-MHz first i.f. and 455-khz second i.f. The first oscillator uses one of the 33-MHz crystals that is between 5.995 and 6.035 MHz *above* the incoming signal frequency. The 6-MHz output of the first mixer beats against a 6.4-MHz (6.490, 6.480, 6.470 or 6.450 MHz) signal from the second oscillator to produce the 455-kHz second i.f.

To see how this works out, let's see what's needed for transmitting and receiving on channels 1 and 23—26.965 and 27.255 MHz, respectively. On channel 1, 33.000-MHz beats against 6.035 to develop the *difference* frequency (26.965 MHz) that we need. Similarly, when transmitting on 27.255, we beat 33.250 and 5.995 to come up with the desired frequency.

When receiving, we use the same 33-MHz crystals to develop the first i.f—difference frequencies—of 6.035 MHz for channel 1 and 5.995 MHz for channel 23. The second conversion oscillator frequency (6.490 for channel 1 and 6.450 for channel 23) provides te 455-kHz difference frequency for the second i.f. amplifier.

Channel-9 monitor

The monitor section of the transceiver is a crystal-controlled single-conversion superhet that permits the CB operator to keep a constant "watch" on channel 9—the emergency channel set aside by the FCC for calls related to assistance to the motorist and emergency communications involving safety of life or protection of property—while at the same time handling traffic on any of the other 22 channels. A signal on channel 9 flashes a special indicator light on the panel. Pressing a switch transfers the output of the monitor to the common audio output circuit. To respond to the emergency call, the operator disables the monitor, switches the channel selector to 9 and operates in the normal manner.

Some transceivers include complete transmit and receive circuits for channel 9.

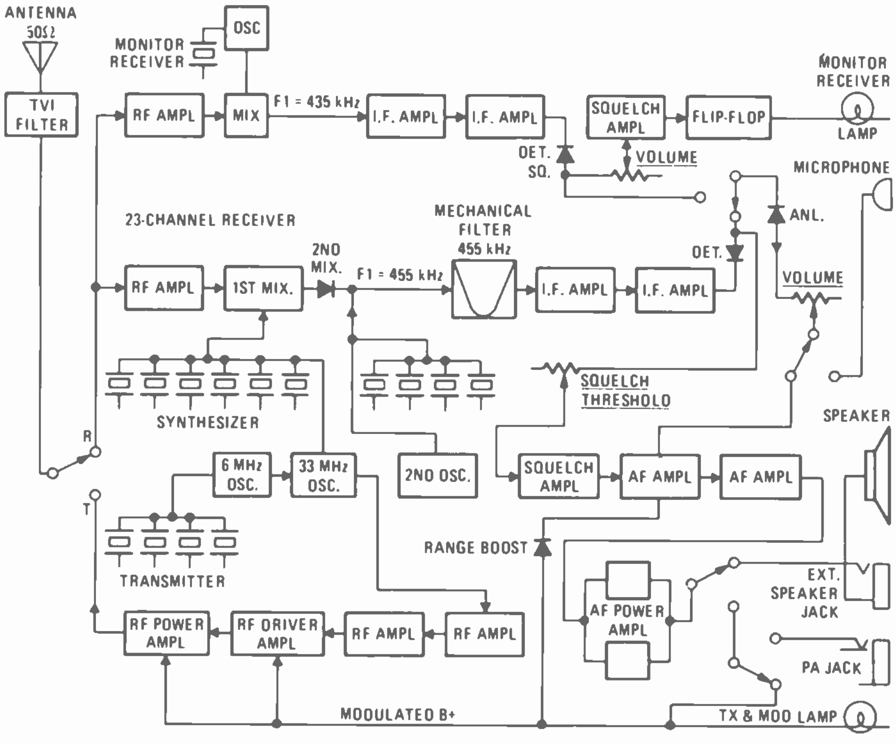


FIG. 1—BLOCK DIAGRAM OF THE MICRO 923, a sophisticated AM rig from Lafayette Radio Electronics featuring frequency synthesis, Range Boost and a channel-9 monitor.

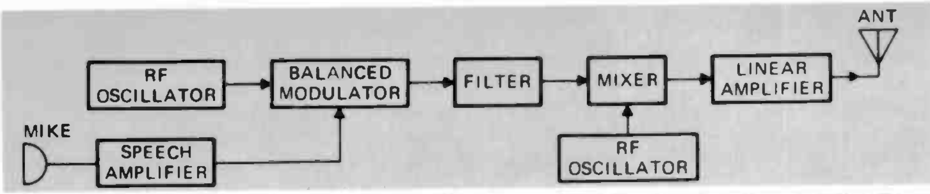


FIG. 2—FILTER METHOD of generating a single-sideband signal. The first rf oscillator is at the filter frequency. The second heterodynes the sideband to the desired frequency.

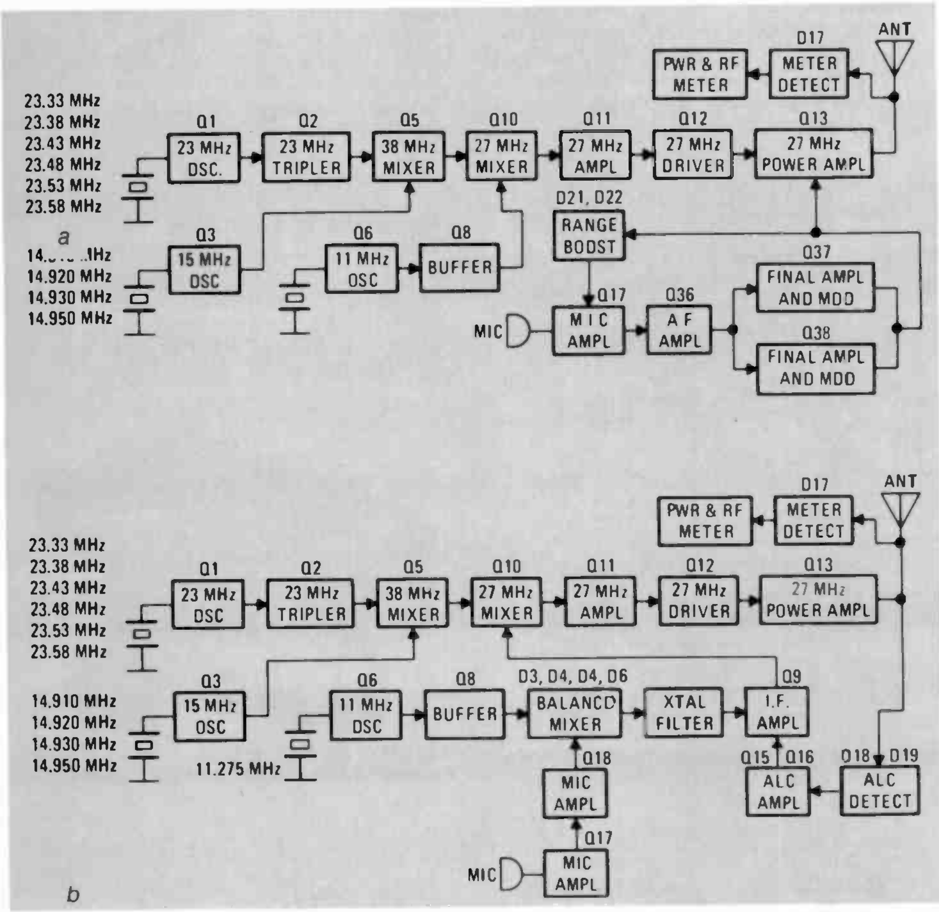


FIG. 3—A COMPARISON OF THE AM AND SAB CIRCUITS in a typical deluxe transceiver. The Range Boost circuits in the AM transmitter (a) are akin to the alc circuits in the SSB mode (b). However, the former works at audio frequencies and the latter at rf.

For example, Radio Shack's Realistic model TRC-49 Navaho Pro Niner includes a synthesized 23-channel, 5-watt transceiver, plus a separate crystal-controlled 5-watt transceiver.

Many of the more sophisticated CB rigs operate in the AM mode and in the single-sideband mode using either the upper or lower sideband as desired. Single-sideband (SSB) operation offers the CB operator quite an improvement in performance over conventional AM. First, when transmitting, all the available legal power can be concentrated in one sideband to provide an effective power gain of around 8 dB (at the receiver). Too, being able to use either sideband at will effectively triples the number of available channels. On receiving, the SSB mode offers improved sensitivity and selectivity and a better signal-to-noise ratio to contribute further to an increase in operating range.

The SSB transmitter

In the SSB mode, the typical CB transceiver uses the balanced modulator/filter combination (Fig. 2) to generate the single-sideband signal. The rf oscillator signal—at the filter frequency—combines with the audio signal in the balanced modulator so the carrier (the rf oscillator frequency) is suppressed and only the upper and lower sidebands appear in the output. The filter—generally a mechanical or crystal-lattice filter in the range of around 5.6 to 11 MHz—has sufficient selectivity to pass one sideband while rejecting the other.

The SSB signal from the filter is then mixed with an rf signal from the synthesizer, or an rf oscillator, to produce output on the desired 27-MHz channel after being amplified in a *linear* amplifier. In the LSB mode the rf injection frequency is the *difference* between the carrier and filter frequencies. When the upper sideband is transmitted, the rf injection frequency equals the *sum* of the carrier and filter frequencies.

For example, take the Pace *Sidetalk* model CB 1023 that incorporates a 7.8025-MHz crystal filter. Consider channel 13 (27.115 MHz). On the lower sideband transmit (and receive and AM transmit) the rf injection frequency required for 27-MHz output is 19.3125 MHz (27.115 − 7.8025). For USB transmit and receive the injection frequency is 34.9175 (27.115 + 7.8025) MHz.

The circuitry used when the transmitter is used in the AM mode is quite simple compared to that used for SSB operation—even when frequency synthesis is used for carrier generation. On AM, we generate a 27-MHz signal, amplify it to the desired output level and then use an audio power amplifier to modulate the B+ supply to the rf power amplifier.

Fig. 3-a is a block diagram of Lafayette's Telsat SSB-50 transceiver when transmitting in the AM mode. The Range Boost circuit maintaiss a high level of modulation without over-modulating. The feedback or control voltage is tapped off the high side of the modulation transformer secondary. The modulator's output is sampled, rectified by D21 and D22 and then filtered to develop a variable bias to control the gain of the mike preamplifier.

Compare Fig. 3-b, the block diagram of the SSB-50 when transmitting on the upper sideband—with Fig. 3-a. (When operating on the lower sideband, the circuit is the same except in the 15-MHz oscillator. On LSB, the frequencies of the four crystals are each 3 kHz lower than those used in the USB mode.)

The alc circuit—alternatively called automatic load control and automatic level control—is a form of delayed agc that is applied to the transmitter to insure that the modulation peaks do not drive the linear power amplifier so hard that it operates in the nonlinear region. A portion of the output of the final (linear) amplifier is tapped off and rectified to provide a dc control voltage for the alc amplifier—a dc amplifier controlling the bias for the i.f. amplifier following the crystal filter.

The SSB receiver

The receiver in the SSB rig is generally a double-conversion superhet with the first i.f. centered on the filter frequency. The incoming signal passes through a broadband 27-MHz amplifier to the first mixer where it combines with the local oscillator signal from the synthesizer. The local oscillator frequency is *below* the signal frequency in the LSB and AM modes and *above* the signal in the USB mode.

The receiver in the AM/SSB rig includes a Noise Blanker and automatic noise limiter (anl) to eliminate impulse-type noise on SSB and AM signals, respectively; envelope-type AM detector, product detector for SSB and separate agc circuits for AM and SSB. We will now cover some of these features in detail.

Noise elimination

Impulse-type noise as from automobile ignition systems and atmospherics can make CB reception very difficult if it is not eliminated. The AM noise limiters generally use a pair of diodes biased to clip the noise pulses at the level of a 100% modulated signal. In the SSB mode, the noise eliminator—called a noise blanker—is designed to eliminate the noise pulse before it reaches the selective circuits in the receiver. Figure 4 is the noise blanker circuit in the Pace *Sidetalk* CB-1023 transceiver.

The incoming signal—along with any noise pulses—is amplified in the rf amplifier and converted to a 7.8-MHz i.f. signal in the mixer. In the absence of noise, the i.f. signal passes through D4 to the crystal filter and on to the i.f. amplifier. The noise component is rectified by D5 and D6 to produce a positive pulse that is differentiated by C413 and R411. This differentiated pulse is fed to the gate of the FET where it is amplified to the level needed to control gate diode D4. The amplified noise pulse back-biases D4 so it cuts off for the duration of the noise pulse. Thus the receiver's signal path is interrupted and the noise pulse is eliminated before it reaches the i.f. circuits where it can cause "ringing" in the high-Q selective circuits.

Agc circuits

In an AM receiver, agc voltage is developed by the audio detector or by a special agc detector. This dc voltage varies with carrier level. There is no carrier on an SSB signal so special agc circuits are needed to hold the receiver's output signal relatively constant. In some sets SSB agc is obtained by rectifying the audio in a full-wave rectifier to develop the dc bias voltage to control the rf and/or i.f. amplifiers.

In the Pace *Sidetalk*, the agc circuit is as shown in Fig. 5. The output of the last i.f. amplifier is used to develop two levels of voltage. The voltage tapped directly off the i.f. output collector is fed through the 47.pF capacitor to D14 and D15 to develop the low *attack* agc voltage. The higher voltage is the *release* agc voltage developed by D12 and D13. Resistor R429 and capacitor C452 form the time constant of the release delay. The capacitor returns to ground through diode D17. On SSB, the diode is biased on, connecting the capacitor directly to ground. The release delay is not needed on AM so the diode biasing voltage is removed when the mode switch is in the AM position.

The FET acts as an agc dc amplifier. When a strong SSB signal is tuned in, the agc attack detectors (D14 and D15.) act quickly to charge C434 and C435. The release agc diodes charge C432 with a voltage that acts as a reverse bias on D16. The voltage on C434 and C435 remains constant until the voltage on C432 has bled off through R429.

Automatic level control

The synthesizer and most of the low-level rf and i.f. circuits are common to the receiver and transmitter. In the Pace CB-1023, the rf power amplifier operates Class C on AM and is biased into the A or AB region for linear operation on SSB.

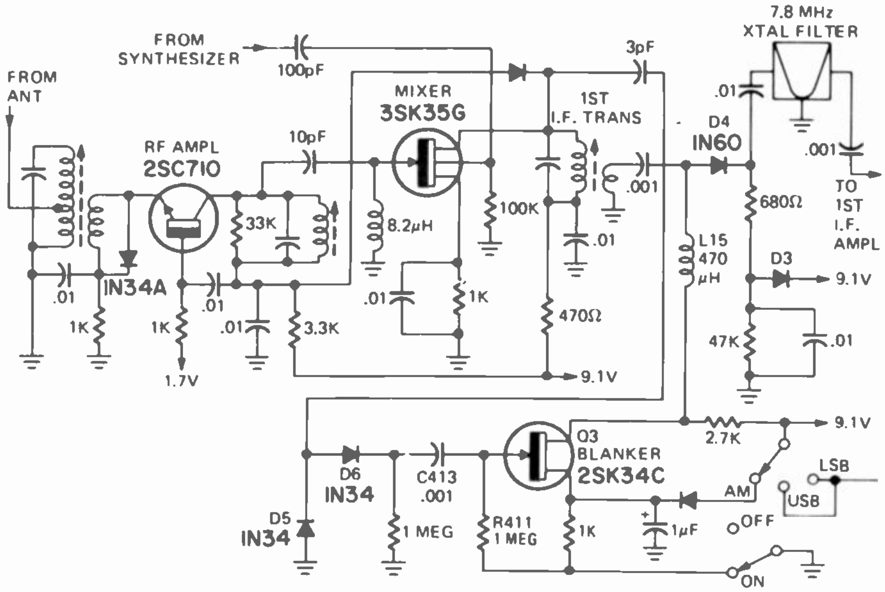


FIG. 4—NOISE BLANKER is a form of i.f. noise limiter. Noise pulses are rectified and amplified to turn off gate diode D4 in the Pace Sidetalk.

MIDLAND MOBILE MODEL 13-862 has top-mounted meter and dial for easy visibility.

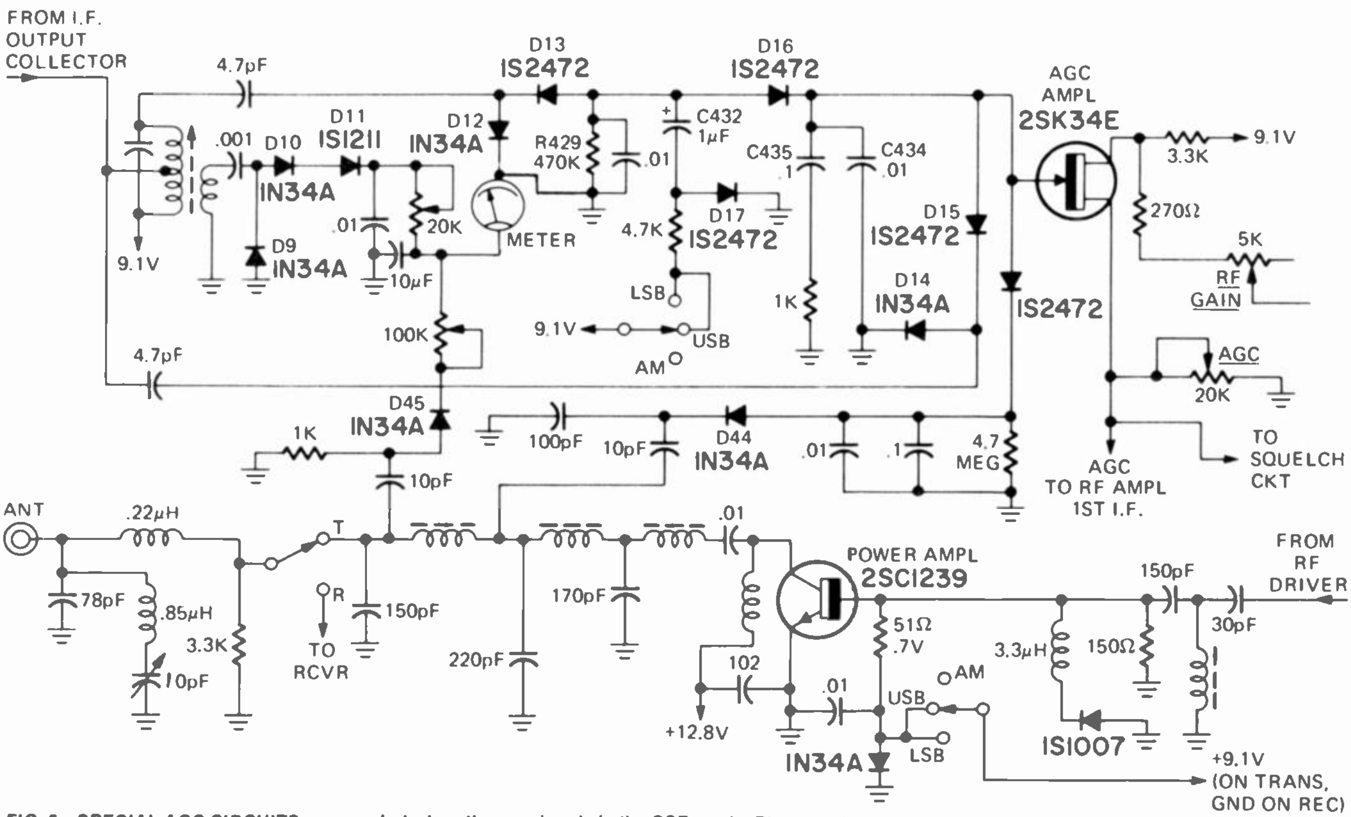


FIG. 5—SPECIAL AGC CIRCUITS are needed when the receiver is in the SSB mode. The agc circuit used by Pace has separate attack and release time-constants for sideband operation.

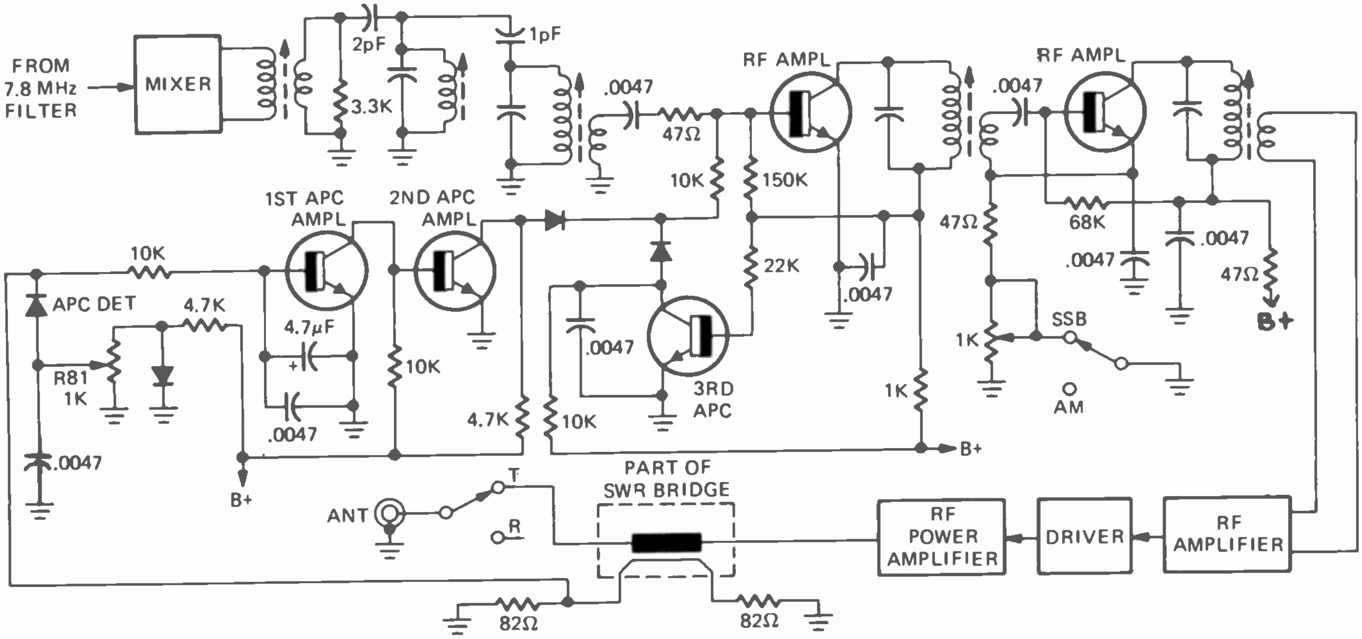


FIG. 6—ANTENNA PROTECTION CIRCUIT in the Tram Diamond 60 disables low-level rf stage to protect the rf power amplifier when the swr on the transmission line rises.

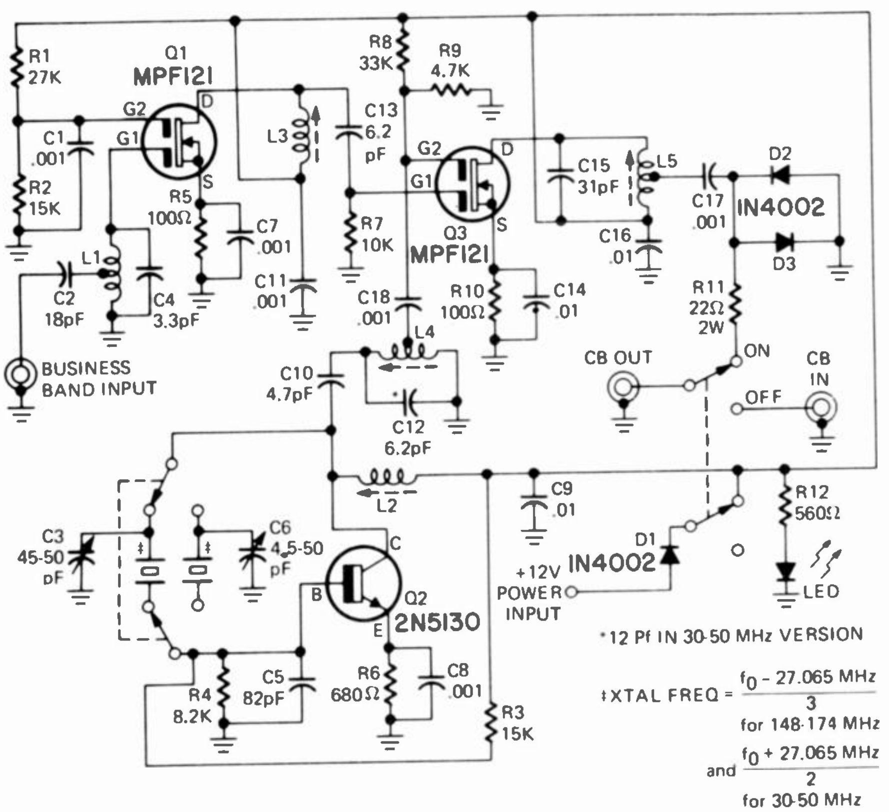


FIG. 7—VHF AND UHF converters for public and emergency services feed their output signals into a CB rig on channel 9. The two vhf Ascom translators use this circuit.

In the alc circuit, a portion of the rf output voltage is tapped off the antenna tuning network, rectified, filtered and applied as gate bias to the FET agc amplifier. When transmitting, this agc amplifier controls the gain of low-level rf stages ahead of the rf driver and power amplifier.

The alc circuit is adjusted by setting the mode switch in the LSB positon on channel 13. A 1-kHz tone is fed into the mike at a level high enough to produce 9 or 10 watts output. A trimmer pot in the agc circuit is set for 8 watts output.

The meter indicates the relative strength of incoming signals when receiving and rf power output when transmitting.

Swr fail-safe circuit

Solid-state rf power amplifiers are particularly vulnerable to damage from high voltages caused by a high standing-wave ratio on the antenna transmission line. Thus, an unprotected rf output stage can be damaged by a high SWR resulting from an off-resonant antenna, a poor ground or ground-plane or a defective lead-in.

The Tram Diamond 60 transceiver employs a circuit to remove the drive to the final linear amplifier when the SWR rises above a preset level. Figure 6 is a simplified schematic of the Tram apc (*a*ntenna *p*rotection *c*ircuit). The section of the swr bridge that develops reflected voltages is used as the control element. The rf voltage developed by a high swr is rectified, amplified in a 2-stage dc amplifier and then fed to the apc control amplifier connected across the base circuit of the first 27-Mhz amplifier. A high swr cuts off the drive to the 27-MHz amplifier circuits.

The circuit is adjusted with a 250-ohm resistor connected across the 50-ohm antenna output terminals. Resistor R81 is adjusted to reduce the rf output to zero across the 250-ohm mismatched load.

Vhf and uhf monitors

Many people engaged in various forms of public and emergency services need to monitor one or two specific frequencies in the 30–50-MHz, 148–175-MHz and 450–470-MHz bands. This has been made

HIGH-BAND VHF CONVERTER from Ascom.

easy by a group of three converters—Antenna Specialists call them translators—that feed into a CB transceiver tuned to channel 9. The narrow-band FM is converted to AM by slope detection.

Figure 7 is the circuit used in the two vhf translators. It consists of a MOSFET rf amplifier with high-Q tuned circuits for maximum sensitivity. This is followed by a dual-gate MOSFET mixer. A 2N5130 transistor is the conversion oscillator. One of two crystals is selected by a push-button switch.

There are many more new and interesting circuit innovations in the latest CB gear but this is all that we have space for in this issue. Watch for more circuit details. R-E

Improvements in

The new and unique innovations in the field of high is lots that's new that has been momentarily to bring you up to date and starts with monplace–Kenwood's double switching demod-

by **LEN FELDMAN**
CONTRIBUTING HIGH-FIDELITY EDITOR

WITH SO MUCH RECENT EMPHASIS IN PRINT on four-channel circuit developments (logic circuits, CD-4 demodulator chips, logic chips, etc.) we tend to overlook some of the really important circuit refinements that continually appear in equipment designed by high-fidelity component manufacturers intent upon improving performance of more "traditional", seemingly perfect components. Two examples of such circuit refinements will be analyzed this month. The first is an improved form of stereo multiplex decoding circuit developed by the engineers of Kenwood Electronics, while the second is representative of a whole new breed of direct-drive turntables which have recently appeared on the market from such companies as Pioneer, Technics (by Panasonic) and Sony, whose servo-controlled electronic turntable will be described.

Double switching demodulation

A block diagram of a conventional switching demodulation circuit used in most stereo FM decoders in shown in Fig. 1. During the positive half cycle of the 38-kHz switching signal, the loop shown by the solid line conducts while during the negative half cycle, the loop shown by the dotted line conducts. The stereo signal, therefore, is "sampled" and separated into left and right outputs. If the switching waveform were a square wave, perfect separation of channels could be achieved.

Actually, however, the switching waveform is a sinewave, either internally generated by a local 19-kHz oscillator-doubler arrangement or by amplification and doubling of the incoming 19-kHz pilot signal. With the use of this kind of switching waveform, it can be shown that the subcarrier would have to be made larger than main channel components by a factor of $\pi/2$ for perfect channel separation to take place at the outputs.

Normally, in simpler circuits, attempts are made to pre-emphasize the high frequency subcarrier components before they are applied to the switching demodulator. Since R-C networks are usually used to do this, it is impossible to boost the entire subcarrier component spectrum (23 kHz to 53 kHz) by an equal amount, and improved separation usually occurs at mid-band audio frequencies only.

Alternatively, differential amplifiers have

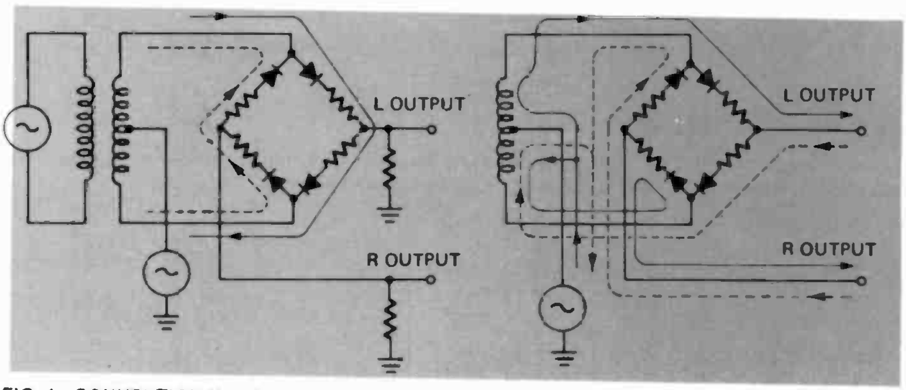


FIG. 1—CONVENTIONAL BALANCED-BRIDGE multiplex demodulator circuit.

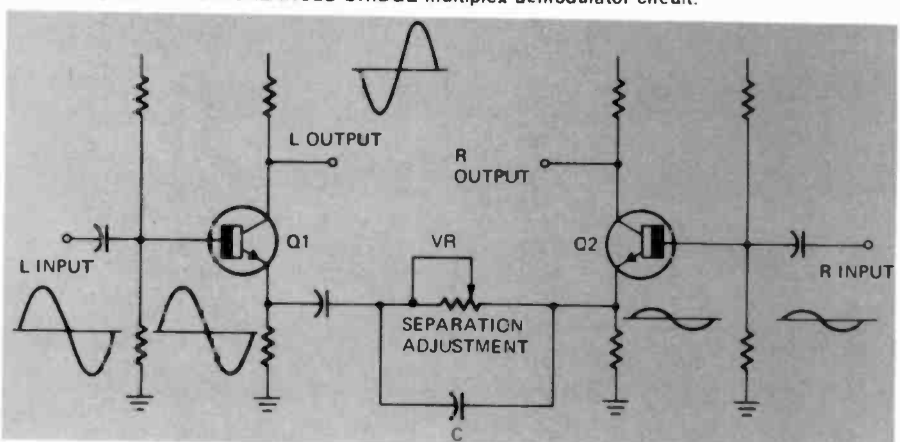


FIG. 2—DIFFERENTIAL AMPLIFIER USED FOR "cross-cancellation" of unwanted crosstalk components following switching demodulator.

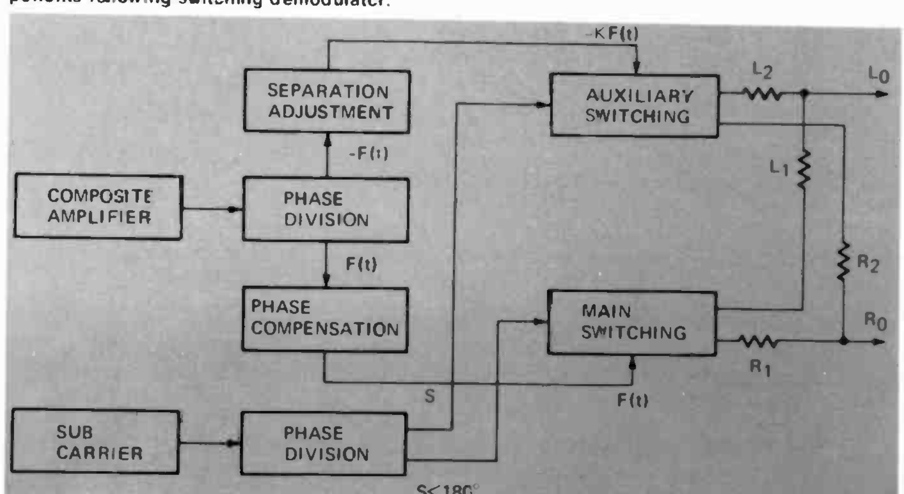


FIG. 3—BLOCK DIAGRAM OF KENWOOD'S DSD multiplex decoding circuit.

Stereo Circuitry

fidelity are not all limited to quadriphonics. There passed over. Our High-Fidelity Editor intends two new concepts that may shortly be com- ulator and Sony's direct-drive turntable.

been used between the output amplifiers of more elaborate decoder circuits, as shown in Fig. 2. If we assume that the recovered "L" output really consists of $L + 1/a(R)$, [where $1/a(R)$ is the unwanted cross talk appearing there because of improper switching demodulation]: then if $1/a\,[R + 1/a(L)]$ is fed to the emitter of Q1, the phase inverted input signal *plus* this signal applied to the emitter will appear at the collector of Q1: $-[L + 1/a(R)] + 1/a\,[R + 1/a(L)]$, which, expanded, equals: $-L - 1/a(R) + 1/aR + 1/a^2L = -(L - 1/a^2L)$.

The R component is completely removed. Potentiometer VR adjusts the 1/a signal. Capacitor C compensates, to some degree, for level and phase of the higher frequency range of the demodulation differential signal. The reverse analysis holds true for the "R" recovered signal. Even with this more sophisticated approach, it is difficult to make the level differential between main and sub channel components equal over the entire 50-Hz to 15,000-Hz audio range. Normally, additional phase and amplitude differences are produced in earlier parts of the multiplex circuit because of SCA filter circuits which are usually present in typical decoder circuits.

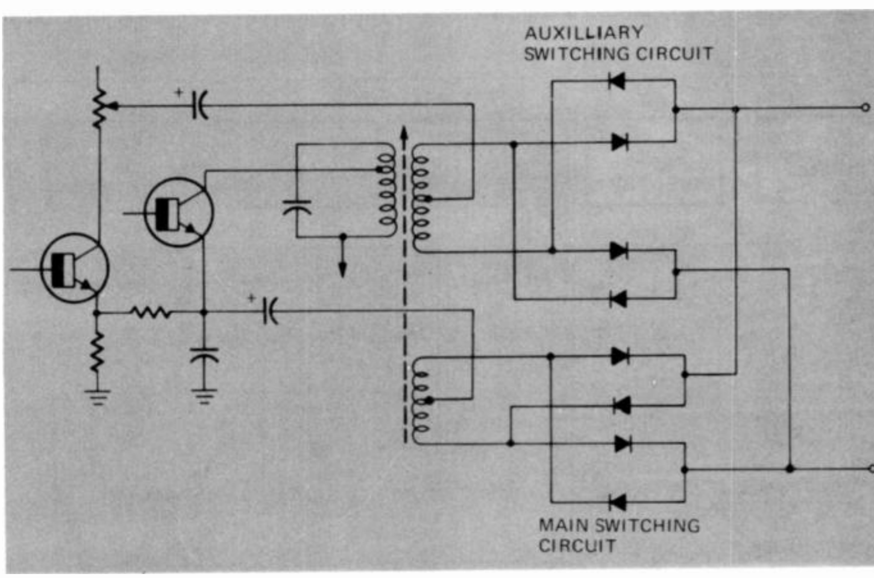


FIG. 4—ACTUAL PARTIAL SCHEMATIC shows main and auxiliary diode bridge circuits used in the Double Switching Demodulator.

Kenwood's Double Switching Demodulation system was developed to solve these problems. A block diagram of the system is shown in Fig. 3 and a portion of an actual circuit is shown in Fig. 4.

A composite stereo signal can be represented by the general formula:

$$F(t) = L + R - (L - R)2\pi 38000t.$$

In the circuit of Fig. 4, this function is divided into F(t) and −F(t) by the phase division circuit. The −F(t) is reduced in amplitude by coefficient K through the separation adjustment potentiometer and is applied to the auxiliary switching circuit. The 38-kHz subcarrier signal is applied to the two switching circuits 180° out of phase with respect to each other. If we consider the 38-kHz subcarrier to be in the form of a square wave, it can be expressed by the following formula, corresponding to its negative and positive half cycles:

$$S_1(t) = \tfrac{1}{2} + 2/\pi \sin 2\pi 38000t - 2/3\pi \sin 2\pi 38000t + \ldots$$

and

$$S_2(t) = \tfrac{1}{2} - 2/\pi \sin 2\pi 38000t + 2/3\pi \sin 2\pi 38000t - \ldots$$

If only the audio component is extracted, the main switching circuit output becomes:

$$L_1 = F(t) \times S_1(t) \cong (\tfrac{1}{2} + 1/\pi)L + (\tfrac{1}{2} - 1/\pi)R$$

$$R_1 = F(t) \times S_2(t) \cong (\tfrac{1}{2} + 1/\pi)R - (\tfrac{1}{2} - 1/\pi)L$$

The outputs from the auxiliary switching circuits become:

$$L_2 = -KF(t) \times S_2(t) \cong -K\,[(\tfrac{1}{2} + 1/\pi)R - (\tfrac{1}{2} - 1/\pi)L]$$

and

$$R_2 = -KF(t) \times S_1(t) = -K\,[(\tfrac{1}{2} + 1/\pi)L + (\tfrac{1}{2} - 1/\pi)R]$$

The combined outputs then become:

$$L_o = L_1 + L_2 = [(\tfrac{1}{2} + 1/\pi) - K(\tfrac{1}{2} - 1/\pi)]L + [(\tfrac{1}{2} - 1/\pi) - K(\tfrac{1}{2} + 1/\pi)]R;$$

and

$$R_o = R_1 + P_2 = [(\tfrac{1}{2} + 1/\pi) - K(\tfrac{1}{2} + 1/\pi)]R + [(\tfrac{1}{2} - 1/\pi) - K(\tfrac{1}{2} - 1/\pi)]L.$$

From the above, it is easy to see that to remove the "R" component from the L_o output and the "L" component from the R_o output, value K must be set to equal:

$$K = \frac{\pi - 2}{\pi + 2}$$

or approximately 0.222.

The DSD circuit, therefore, cancels unwanted crosstalk components and, as a byproduct, helps reduce residual subcarrier components in the outputs as well. By including a phase compensation circuit in the main switching diode arrangement, separation deterioration due to phase shifts be-

FIG. 5—KENWOOD'S KR-6340. One of many models using DSD circuit in stereo decoding section. Unit is a Quadriphonic receiver.

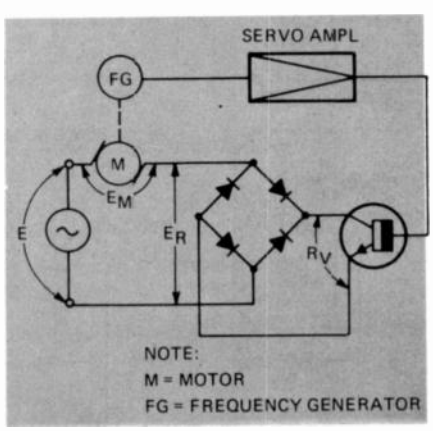


FIG. 6—PRINCIPLE OF SERVO-CONTROLLED motor in Sony PS-2251 direct-drive turntable.

tween main and sub-channel signals, appearing in the higher audio frequency range, can be eliminated. Typically, separation well in excess of 30 dB is reached at 10 kHz using the DSD circuit. Another improvement in performance is reduced amplitude of "interference frequency beats" sometimes caused by the interaction of residual 19-kHz and 38-kHz products and high frequency program signals. Figure 5 shows Kenwood's new four-channel receiver, Model KR-6340, one of many receiver and tuner models which employ this DSD stereo decoding principle.

Direct drive turntable system

Less than .04% (weighted) wow and flutter, and a signal-to-noise ratio of better than 58 dB (weighted) are just two of the impressive specifications claimed for the new Sony PS-2251 Direct Drive Turntable System. These and other superb specs result from using an ac servo-controlled motor which is directly coupled to the turntable. This eliminates idler wheels, belts, pulleys or any other speed-reduction schemes normally associated with turntables and record changers.

Figure 6 is a simplified diagram of the servo system in this unit. Motor speed is proportional to the applied ac voltage and is controlled by varying the applied voltage E_m to the motor. Voltage variation is controlled by the diode bridge and the collector-emitter impedance (R_V) of the power transistor.

Motor speed is converted into an ac signal by a frequency generator directly coupled to the turntable motor. A servo-amplifier compares this signal with a very stable dc reference voltage and controls the impedance of the power transistor. Any error in motor speed generates a correction voltage which is then applied to the motor.

A more detailed analysis of the servo action can be gained by examining the block diagram of Fig. 7. When the main power switch is turned on, C8 is charged through VR2, R10, VR1 and R9 when the controls are set to 33-1/3 rpm. Note that for 45 rpm operation, VR2 and R10 are shorted out. The voltage comparator circuit in IC1 is biased into conduction when C8 is charged to a predetermined voltage. As a result, Q3 and Q4 are turned on and an ac voltage is applied to the motor.

A frequency generator (FG) is directly coupled to the drive motor shaft and generates an ac voltage whose frequency is proportional to the motor speed. Q1 and Q2 form a differential amplifier which increases the level of the generated signal to that required by limiter diodes D1 and D2. These diodes conduct whenever barrier potential of 0.6 volt is exceeded, limiting their output signal to 1.2 volts, peak-to-peak.

The integrated circuit (IC1) which follows contains four separate circuit elements: a flip-flop, a dc buffer amplifier/phase inverter, a sawtooth waveform generator and a voltage comparator. The flip-flop produces square-wave output frequencies based upon the input-limited trigger signal. The dc buffer/phase inverter amplifies and inverts the square wave signals which are then converted into spike-shaped pulses through a differentiation circuit (C7 and the input impedance of the sawtooth waveform generator that follows). The frequency of the sawtooth is determined by the externally connected time constant circuits (C8, R9, VR1, R10 and VR2).

The voltage comparator generates negative pulses whose width is proportional to the time the sawtooth voltage exceeds the reference voltage. The reference voltage is determined by the pitch control (VR3) setting. The dc buffer/phase inverter stage which follows supplies positive pulse signals to the low-pass filter circuit and buffer amplifier Q3. The low-pass filter has a sharp roll-off characteristic and acts as an integrating circuit, converting the positive input pulses into a dc voltage proportional to the input pulse-width. Dc output from the low-pass filter is applied to the base of Q4. Since Q4, Q5 and Q6 are all directly coupled, a change in input dc voltage alters the conduction of Q6 which varies the voltage applied to the turntable motor.

Waveforms appearing at various points numbered in Fig. 7 are illustrated in Fig. 8.

Speed variation and control

If motor speed should vary, becoming

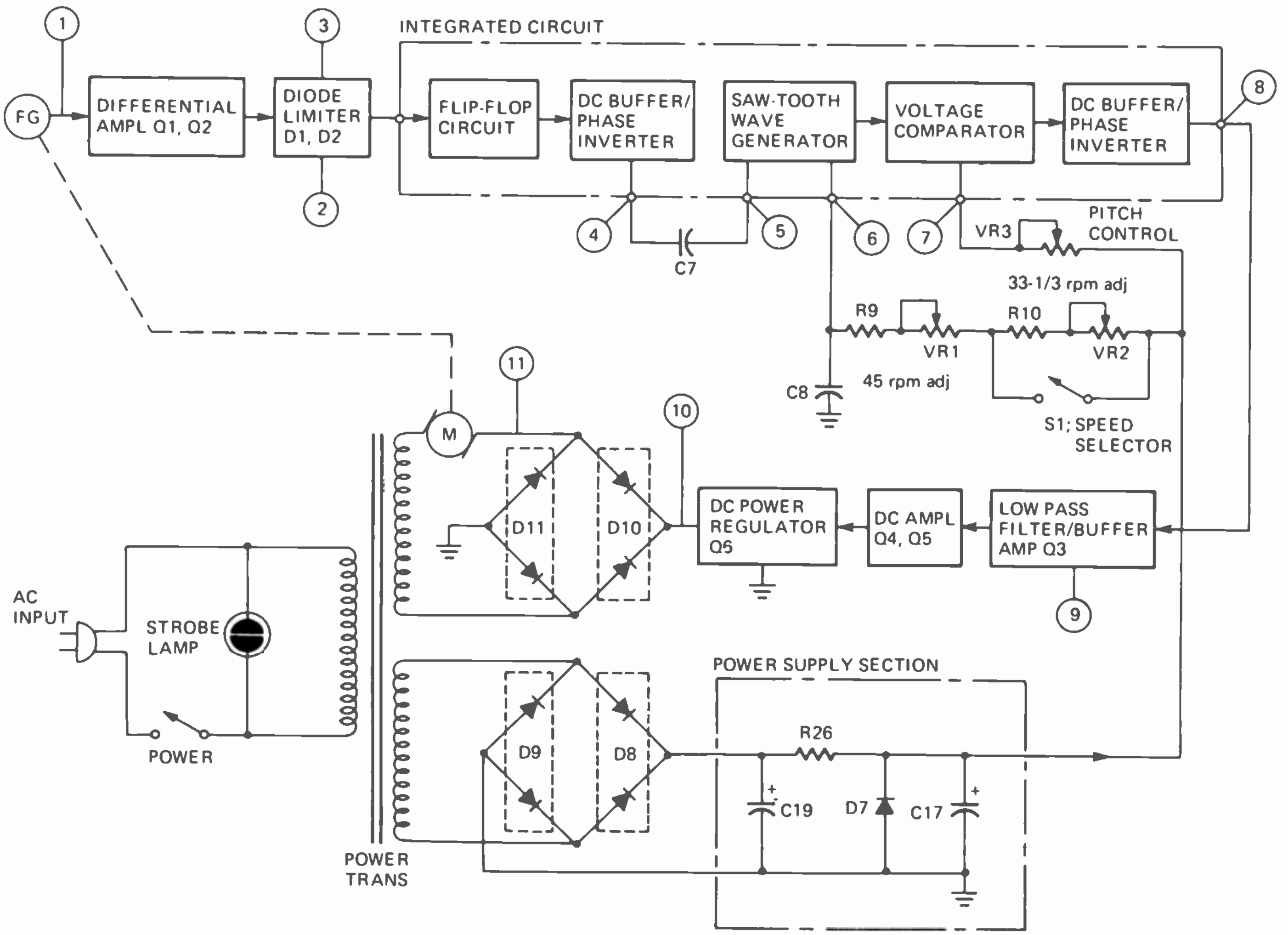


FIG. 7—COMPLETE BLOCK DIAGRAM of circuits used in Sony PS-2251 direct-drive turntable system. Circled numbers refer to waveforms shown in Fig. 8

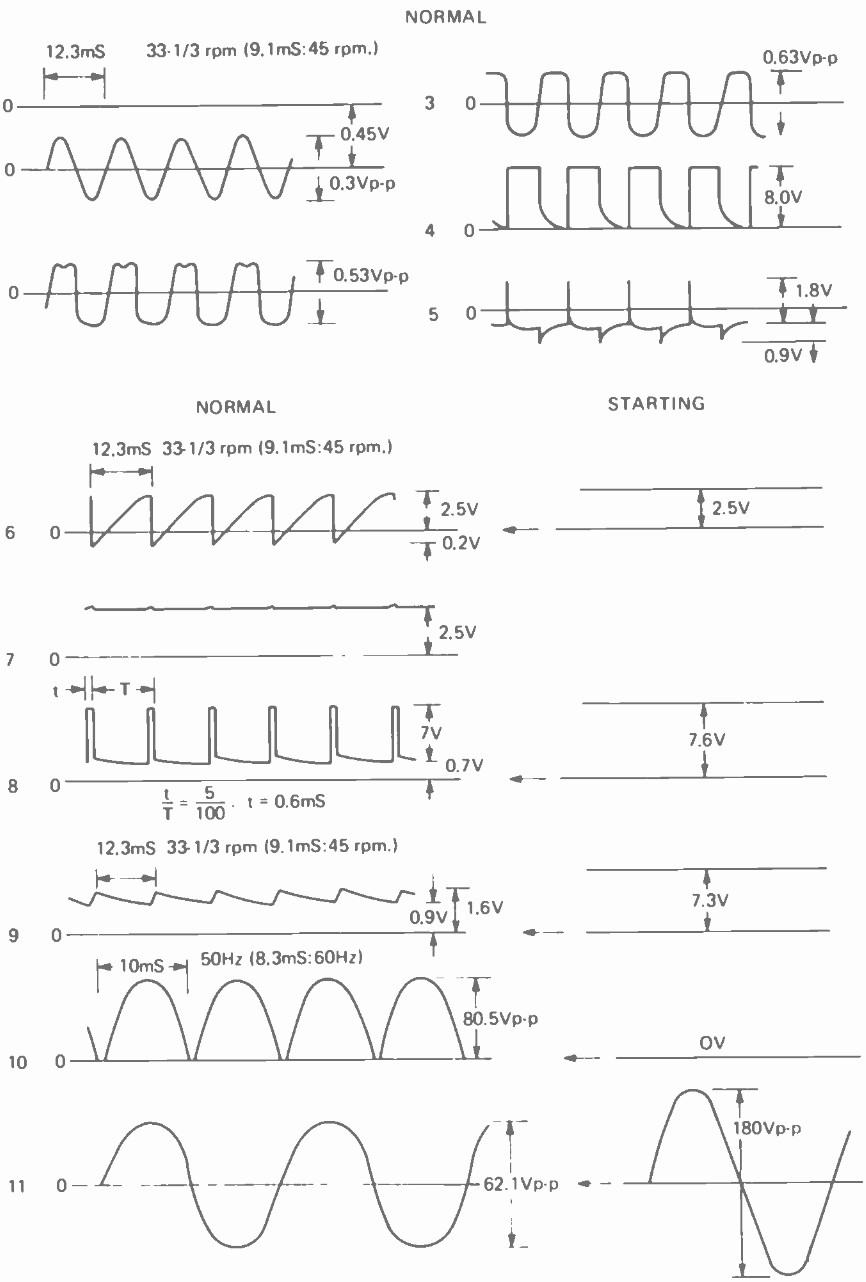


FIG. 8—WAVEFORMS appearing at numbered points in the block diagram of Fig. 7.

either too fast or too slow, the servo system compensates and adjusts the speed. Let's assume that the motor starts to run too fast. The frequency generator signal frequency increases, which results in shorter intervals between the pulses used to trigger the sawtooth waveform generator. This causes lower-amplitude sawtooth waveforms which in turn result in a shorter "ON" period for the comparator. The output waveform from the comparator then is reduced in pulse width, thereby reducing the positive bias applied to Q4. As a result, the collector impedance of Q6 increases, reducing motor speed. Conversely, if the motor speed tends to decrease, the collector-emitter impedance of Q6 is made to decrease, thereby increasing the motor speed.

Positive 12 Vdc for the system is provided by the full-wave rectifier consisting of D8 and D9, filter capacitors C19, C17 and Zener diode D7.

Speed changeover from 33-1/3 rpm to 45 rpm is done by changing the sawtooth waveform frequency externally. Since the sawtooth waveform frequency is determined by the external RC time constants, a speed selector switch is connected across VR2 and R10. Shorting out these two components results in faster motor speed (45 rpm) and the switch is set to the open position for slower, 33-1/3 rpm operation.

A top view of the complete turntable assembly is shown in Fig. 9, in which the associated statically balanced tone arm and the front panel speed selector buttons and pitch control knob are visible. Figure 10 shows the underside of the system. The circuit board containing the servo-electronics is seen alongside the direct-drive motor housing. The actual motor used is an eddy-current ac motor with a cup-shaped copper rotor which generates smooth linear rotating torque. Because of the nature of the motor drive system, the turntable system can be used with either 50-Hz or 60-Hz house current, since, unlike hysteresis motors found in speed-reduction systems, the incoming power line frequency has little to do with the ultimate speed of the drive motor. Since some variation in strobe light effect would take place when switching from 50-Hz to 60-Hz house currents, the illuminated strobe lines visible through a window in the front edge of the unit are repeated for 50 Hz use and differ from the set inscribed for 60 Hz operation. **R-E**

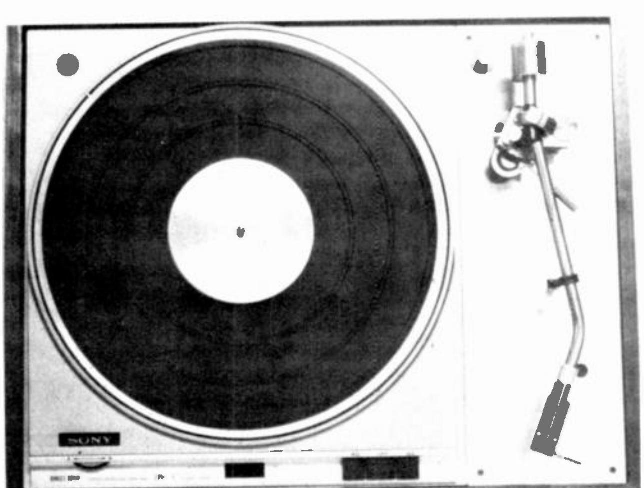


FIG. 9—TOP VIEW OF SONY PS-2251 turntable/tone arm assembly.

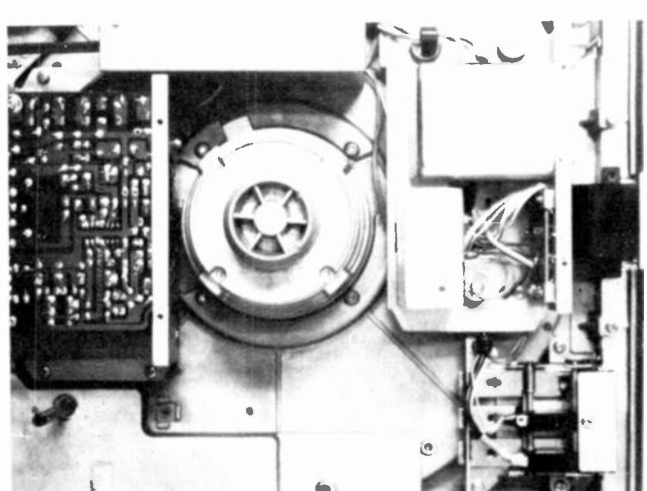
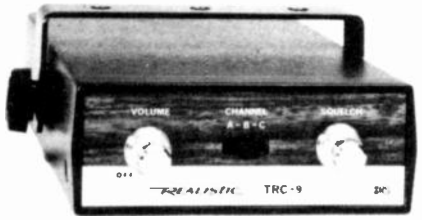


FIG. 10—UNDERSIDE OF PS-2251 shows circuit board for servo-control electronics mounted adjacent to direct drive ac motor.



CB Alignment

RADIO SHACK'S REALISTIC TRC-9 works on channel 9 and two other channels.

Alignment of CB receiver and transmitter circuits is simple and need not require precision test instruments and a laboratory setup. Use another CB rig as your alignment equipment.

by ANDREW J. MUELLER

IF THE ALIGNMENT OF YOUR CB RADIO is not right on the button, you can have problems! Weak or noisy reception, splatter from adjacent channels, are the commonest troubles you can run into if the alignment is off. Misalignment has various causes. The first and biggest is "diddl-itus". This results from the would-be technician—armed with a handful of alignment tools—attempting to "just tweak it up a little". The rest of the causes include from normal aging, parts replacement or defective associated components.

Aligning a CB radio is easy once you become familiar with the procedure. The first thing you need to start with is a set of proper alignment tools. This is no place for metal screwdrivers or Allen wrenches. When these metal tools are withdrawn from the coil, they can detune the circuit you have just aligned. If the tool size is not right, the slugs can be cracked or broken and will have to be replaced. The following alignment tools should cover just about every radio.

1 GC 8282 1 GC 8276 1 GC 5097
1 GC 9304 1 GC 2520

These can be purchased through any radio parts distributor for around $3.00. Next you will need a 20,000 ohms per volt vom or vtvm and another CB unit with a dummy load. A walkie-talkie is OK but a 5-watt unit is better.

Referring to the schematic of SBE *Capri* in Fig. 1, hook up the voltmeter at point A to ground. Set the meter on the 5V dc scale. Connect the other CB radio to a dummy load, place it in the vicinity of the unit to be aligned and set both to the same channel. Transmit and observe the meter reading on the set to be aligned. If the meter reads over 3 volts, move the sets farther apart until you get a reading of between 1 and 2 volts. Now take the proper alignment tool and adjust L9 through L4 for a peak reading on the meter. If the reading goes over 3 volts at any time, move the sets farther apart. This will make sure that you are not overloading the unit. If any of the coils will not peak, try reducing the signal input and try to retune. If this fails, you must troubleshoot the radio. More than likely you will find an open resonating capacitor or defective associated components. Once this is corrected, you can continue the alignment.

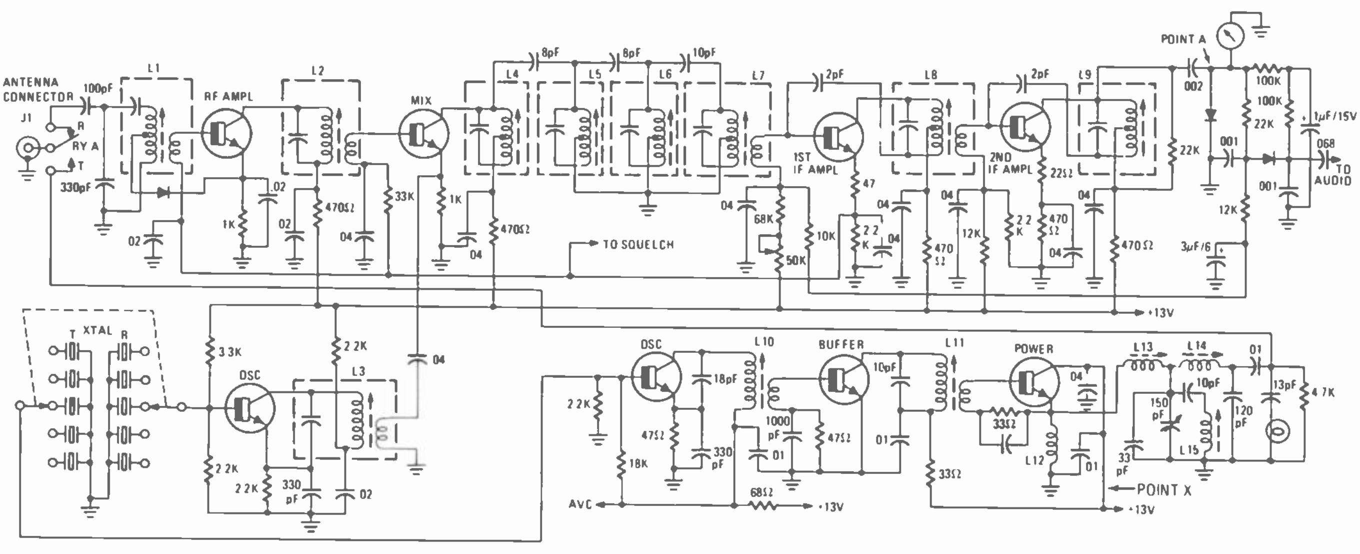
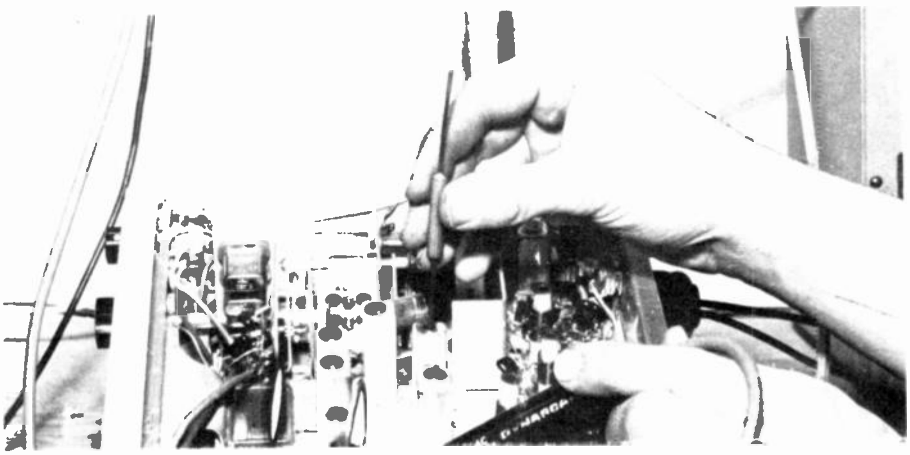


FIG.1—THE SBE CAPRI, partial schematic showing those portions on which the technician will work when aligning the transmitter and receiver. Circuits are typical of AM-only transceivers.

Made Easy



When all of the i.f.'s are aligned, the only thing left to do is to tune the front end. Leave the meter connected and hook an antenna to the unit. Select a quiet channel between channel 9 and 12. While receiving a weak signal tune L1 and L2 for maximum. Peak the receiver local oscillator coil, L3, for maximum reading. Then back it off about 1/2 turn. Check the oscillator operation by switching channels and noting if all of the receive crystals "fire". If they all do not, back off another 1/8 to 1/4 turn and check again.

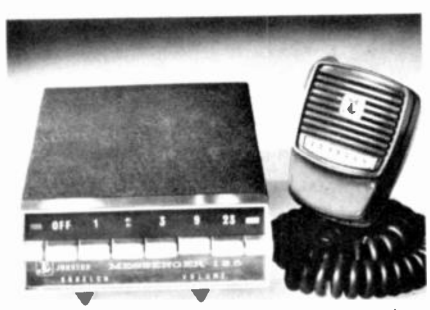
ALIGNMENT TOOLS and kit. The suggested GC-5097 (not shown) is for K-Tran i.f.'s.

This completes the alignment. We are assured that the receiver is on frequency because it has been tuned to another unit that is working normally and is on frequency.

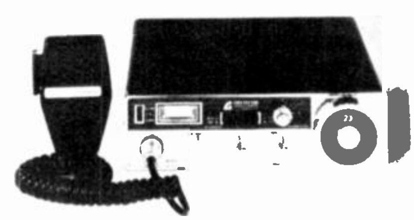
The transmitter

The last section to align is the transmitter. Connect an indicating type dummy load to the antenna jack. Do not use the type that uses a No. 47 lamp, but rather a unit similar to the Courier Porta-Lab. Depress the mike switch and observe the output. Adjust L10 for maximum output. This must be done carefully to insure proper oscillator operation. Follow the same procedure as you did when L3 was adjusted above. Next adjust L11, L13, and L14 for maximum output. When adjusting L13, make sure that this is set so that when you talk, the output power increases. Keeping in mind that the power input is also adjusted by L13 and L14, the input power must be checked to not exceed 5 watts. This can be done by inserting a 0-500 mA meter at point X. Take this reading in mA and multiply it by the voltage measured to ground at this point. The resultant figure should not exceed 5,000 mW (5 watts). If it does, adjust L13 for a lower mA reading while still maintaining upward modulation. If upward modulation cannot be obtained within the 5-watt limit, take the set to a CB servive center for repairs.

THE HY-RANGE V is a synthesizer AM/SSB rig whose circuitry is more complex.



MESSENGER 125, a 5-channel AM rig featuring pushbutton switching.

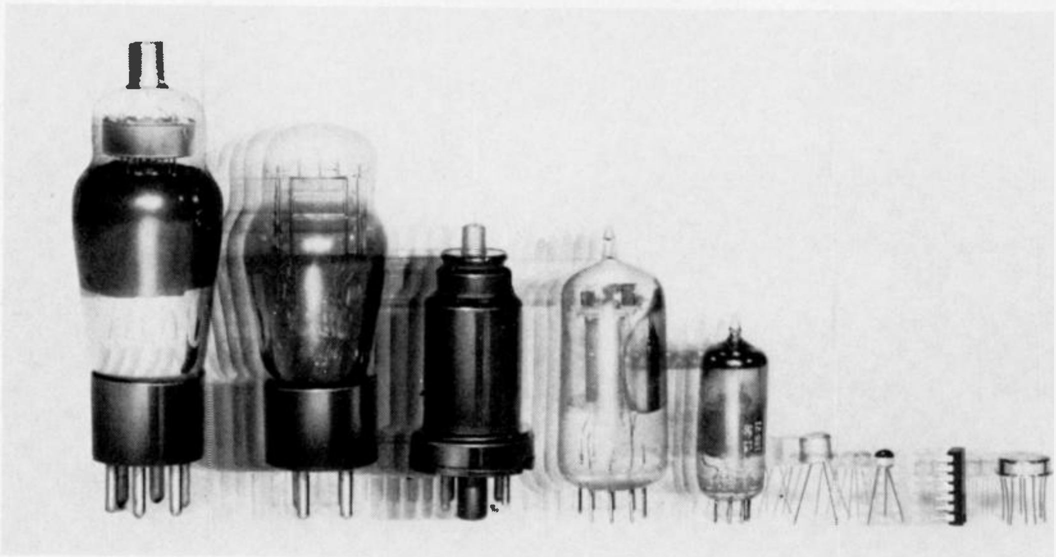


THE CHEETAH is a SSB synthesizer rig. Leave frequency determining circuits alone.

L15, the TVI trap, is the last adjustment to make. This is done by tuning a nearby TV set to channel 2 and adjusting L15 for minimum TVI.

This completes the alignment of the unit. While you make the above adjustments on a dummy load, *all final adjustments must be checked by an FCC licensed technician*. This must be done before the set is put on the air. It is required by the rules and regulations, and you can be assured that you did the job right. You also will be avoiding a citation from the FCC. **R-E**

Changes come fast in electronics.



From tube to LSI 

Take a look at the race in circuit technology. In the 1960's the tubes at the left made way for the transistors at the right. Today, transistors are surpassed by the large scale integrated circuit (LSI) at the far right. This circuit, less than a quarter inch square, replaces over 6000 transistors!

There's big money to be made by the men who stay ahead of this technology race. Put yourself ahead with NTS Home Training! You get the latest, most advanced equipment (at no extra cost). More solid-state units, and more advanced technology. Plenty of training with integrated circuits, too! As an NTS graduate, you enter a world of electronics you're familiar with. You have a thorough working knowledge of solid-state circuitry. You're ready to tackle bigger jobs at higher pay!

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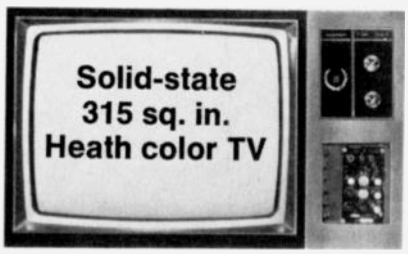

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Solid-state B & W TV, 74 sq. in. picture (cabinet included)

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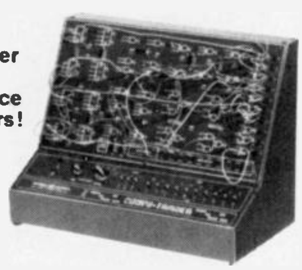

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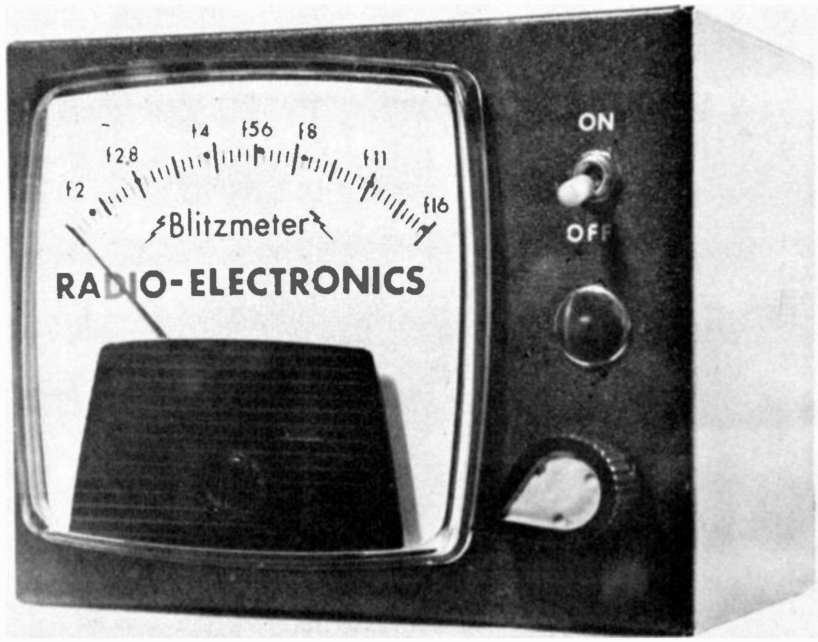
5-watt AM transmitter/ receiver

build a BLITZMETER

by JAMES A. GUPTON
PHOTOGRAPHIC EDITOR

WHAT PHOTOGRAPHER WOULD EVER attempt to make an exposure without first measuring the light with a meter? What photographer would attempt to process film without first measuring the temperature of his chemical solutions? Yet, put an electronic photoflash in the hands of almost any photographer and he immediately relies on *guesswork*! His standard exposure meter is valueless for measuring the split-second flash of the electronic photoflash units. He is forced to guess his exposure by the hit-or-miss device known as the "Guide Number."

The GN is a flash exposure factor by which the supposed exposure value can be determined by dividing the GN by the distance from the camera to the subject. While this can be reasonably accurate *if* . . . you are accurate in your mathematics, distance value and . . . your flash unit is fully charged. But what happens to the GN exposure factor if you are wrong or your flash is fired before it reaches full charge? Don't chance it! For just a few dollars for components and an hour or two of time you can have a reliable exposure meter that works on the reflected light from your electronic photoflash unit to provide you with accurate flash exposure data.



ONE VERSION OF THE BLITZMETER. This model uses rectangular meter and point-to-point wiring on peforated board. The other type uses a PC board and an edgewise panel meter.

How it works

The "Blitzmeter" is appropriately titled—the brief duration of the electronic photoflash parallels that of the bolt of lightning in a summer thunderstorm. "Blitz" is the German word for "lightning." The Blitzmeter can be sectionalized into three circuits: The photo detector; the trigger circuit; the metering circuit.

The photo detector has a very high resistance to ambient light, even daylight on a bright and sunny day.

PARTS LIST

All resistors are ¼-watt 10%
R1—4,700 ohms
R2—52 ohms
R3—10,000 ohms
R4—1,000 ohms
R5—22 megohms
R6—150 ohms
R7—27,000 ohms
R8—75,000 ohms Mallory MC-½, ¼ watt
R9—100,000 ohms IRC CTS-X201 carbon trimmor
R10—27,000 ohms**
C1—0.02 µF ceramic, 10 V
C2—100 µF tantalum, 10 V
C3—75 µF, 30 V
PC—Motorola HEP-312, CL902, or CL903
Q1, Q2—Motorola HEP-729, MPS-3710, 2N2219
Q3—Motorola HEP-F2004, HEP-2005, 2N4303, 2N4351, 2N5458
S1—switch spd, miniature type
Battery—22.5 V.
Cabinet—Bud 4×2¼×2¼
Knob—½-in. dia. aluminum, ⅛-in. shaft
Meter—100 microampere, 2½-in.
* HEP numbers and acceptable substitutes
**used only to permit R-10 to adjust meter above or below zero

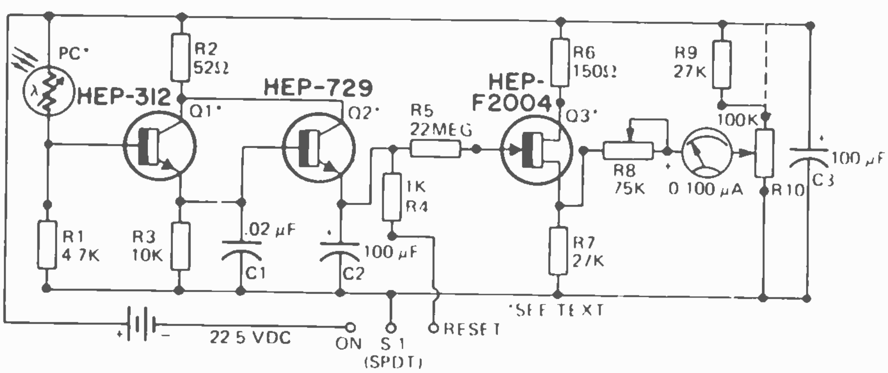


FIG. 1—THE BLITZMETER: It uses only three transistors and one photocell to measure the short-duration flash to an electronic unit.

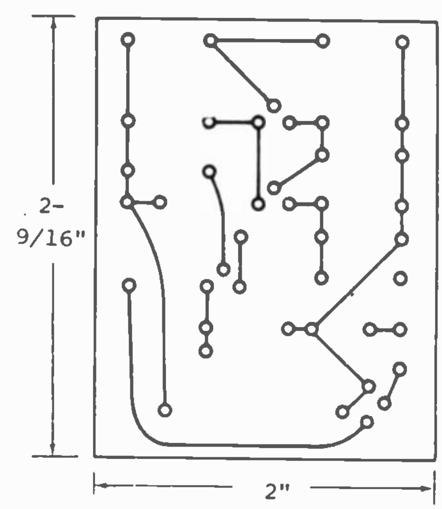


FIG. 2—PRINTED CIRCUIT LAYOUT is shown here full size (2×2-9/16 in.).

INTERIOR VIEW OF A BLITZMETER. This model uses point-to-point wiring on a perforated board mounted directly on the terminals of the panel meter.

This high resistance keeps the trigger transistor circuit biased off until the energy from an electronic photoflash is received. The energy from the photoflash drops the photo detector's resistance enough to "pulse" the trigger circuit that causes transistor Q2 in Fig. 1 to charge capacitor C2 to a value that depends on the amount of bias change in Q1, which is controlled by the total energy of the photoflash light reaching the photo detector, PC. The charge in C2 is then measured by FET Q3 and indicated on the meter. The high input resistance of Q3 prevents discharge of C2; it becomes necessary to connect R4 to ground to provide a discharge path. R8 adjusts the sensitivity of the Blitzmeter for various film speeds and R10 is used to null or zero the meter. Note the double function of S1. The spdt action turns on the power and—in the off position—discharges C1 to ground through R4.

The Blitzmeter may be built on a perforated or Vectorboard breadboard or with a printed circuit. Both methods are used in the models that illustrate the construction. The key component is the photo detector. The Motorola HEP-312 npn silicon phototransistor is ideal for this use. It not only has the necessary high ambient light resistance to keep the trigger circuit in the off condition; it has an epoxy lens, which tends to increase its sensitivity by directing maximum light.

There are limited substitutes for the HEP-312, such as the Clairex CL902 or CL903. You might also find that some npn transistors in the TO-5 can will work when the top of the can is cut off. While there may be other suitable substitutes, the author has tried these and found them workable in the Blitzmeter circuitry. The remaining components may be substituted without hesitation. However, should the action of the meter prove erratic or it is difficult to maintain a fixed reading, look to the possible substitution of the FET as the cause.

TABLE: FILM SPEED AND F-STOPS

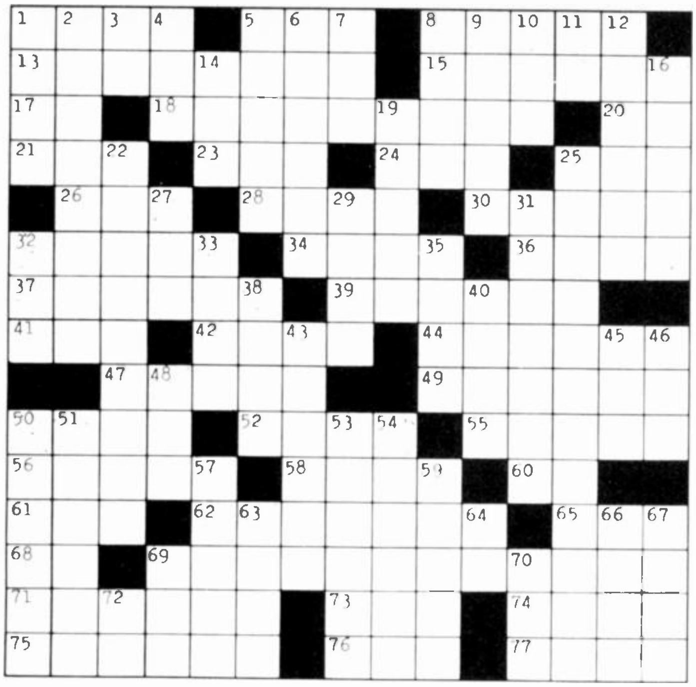
FILM SPEED [ASA]	50 WATT-SECOND Guide Number	100 WATT-SECOND Guide Number	f-STOP FOR 5ft	10ft	20ft
40	55		f 11	f 5.6	f 2.8
		76	f 16	f 8	f 4
65	70		f 16	f 8	f 4
		95	f 22	f 8+	f 5.6
125	95		f 22	f 8+	f 5.6
		125	f 22	f 11	f 6,3
165	110		f 22	f 11	f 6.3
		145		f 16	f 8
400	170			f 16+	f 8+
		250		f 22	f 16

Calibrating the meter

The "Blitzmeter" reads only the photoflash reflected light from the subject and indicates the light value by the meter indication at which the pointer comes to a stop. Calibration is the process of translating the meter indication into usable camera lens f stops and including calibrating potentiometer R8's settings as film speed values in ASA numbers. To assist in calibrating your meter, the Table compares 50 and 100 watt-second photoflash units for guide numbers, film speed, and for typical f-stop values for lens to subject distances.

To calibrate your Blitzmeter, place the meter 5 feet from a neutral gray wall or cloth and discharge the photoflash toward the wall from a position above the Blitzmeter. (Adjust-sensitivity control R8 for maximum resistance.) Now adjust sensitivity control R8 to give full-scale deflection of your meter. Identify this point as f 16—or if your camera lens stops down to f 22, use that value. Next, move Blitzmeter and flash to a distance of 10 feet and repeat the process. Keep the sensitivity control R8 at the initial adjusted setting. The meter pointer will now give a lower indication. Mark it and label it f 8 (or f 11). Now move both units to a distance of 20 feet and repeat the process. Mark the new meter indication f 4. This will calibrate your meter for one film speed only. Place a marker at the sensitivity control and identify by ASA number, using the Table as a guide.

To calibrate for other film speeds, you need only repeat the step at which the meter indicated full-scale pointer movement. At full scale, adjust sensitivity control to move pointer from f 16 (or f 22) to the next *lower* f-stop. In this case, f 11. Mark the sensitivity control for this setting with the next higher ASA number. Now again adjust sensitivity control for the next lower f-stop and mark the setting with the next higher ASA number. This method will enable you to calibrate your Blitzmeter accurately for any specific film speed, while the meter readings will automatically compensate for lens-to subject distance and indicate the proper f-stop setting for your lens. **R-E**



ACROSS

1 Spin below required speed
5 Electric guitarist's burden
8 Component of hi-fi set
13 Yachting events
15 Trued so all parts are correctly adjusted
17 External power supply not needed by Koss electrostatic type stereophones
18 System receiving simultaneous signals on one frequency
20 Loudspeaker hookup
21 Distortion from slowed record speed
23 Unit of music
24 Clear throat
25 "Is Anybody Going to________Antone?"
26 Tape tear
28 Chinese
30 Storage place
32 ___________Ababa
34 Fear of foreigners: _________phobia
36 Used to be
37 Home of the brave
39 Bass loudspeaker
41 Blunder
42 Macaws
44 Armadas
47 Speak without script
49 Skip one dance: 2 words
50 Eat in style, perhaps to music!
52 Invented Stereophones
55 Crisply vigorous
56 Radio communications for "OK, will do."
58 Philippine Negrito
60 Symbol for rhodium
61 Chemical suffix for electro-negative element of a compound
62 Aural coverings of Stereo-phones
65 Harem room
68 Roman six
69 Stereo-times-two sound
71 Enclose equipment in covering material
73 Schubert's "The_______King"
74 Exact path of radio signal
75 Tenant
76 Teletypewriter: Abbr.
77 Capri, for example

DOWN

1 Attract magnetically
2 Tape device for getting music
3 Automatic Gain (Control)
4 Slangy leg
5 Book of maps
6 Quadraphonic system encoding two channels for broadcast, decoded into four by listener equipment. Or, in – discrete!
7 Twenty third Greek letter
8 Story
9 Council of Moslem scholars
10 Nothing doing!
11 Half an em
12 Kind of bills Koss can save you
14 Saturday night watering place
16 Music to wiggle to
19 Record player, for short
22 Responsive to music highs and lows. 2 words
25 The Koss contribution to private listening
27 It's a dandy!
29 Radio fare, besides music
31 Treble loudspeaker
32 Consumed
33 Achieved by fluid-filled stereophone ear cushions
35 Grunts from people punched in the stomach
38 Scandinavian man's name
40 Other side of hit record
43 On the ship
45 Ram, male sheep
46 Untidy place
48 Low mark, in school
50 Sound transmitter in the earcup
51 Antiseptic for bruises
53 Quality is the open______of success
54 British royal house
57 Reclaim for further service
59 Put on, or use a method
63 Amer. Assoc. of Elec. Engrs.
64 Quiet!
66 Radio indication panel
67 Peak of perfection
69 Arabian narcotic shrub
70 Kimono sash
72 Credit note: Abbr.

SOLUTION

TECHNICAL TOPICS

Two of this month's selected circuits are for test instruments–a FET voltmeter and a shorted-turns tester. The others include an unusual regenerative detector; a random-order flasher and a kink for mobile radio operators.

by **ROBERT F. SCOTT**
TECHNICAL EDITOR

FIRST, LET ME THANK THOSE WHO answered my requests for help in selecting material for future Technical Topics columns. I am especially grateful for your kind remarks and for the suggestions that I hope will enable me to tailor future columns to fit your needs. Most of you suggested broad subjects you want to see covered. This is what I need–ideas that can be developed so they are of interest to the greatest number of readers. Technical Topics tries to present workable ideas that you can use directly or adapt to meet more specific requirements.

A few of you wanted answers to specific problems. We don't want Technical Topics to become a Readers' Question Box. If you need immediate help with a specific problem, write to the Technical Editor, or to the Appliance or Service Clinic. We'll do our best to help you.

Several readers wanted a circuit for four or more neon lamps that flash in a random order. The circuit to be used in Christmas decorations, games, "do-nothing" boxes, clearance markers, docking beacons, etc. The circuit in Fig. 1 should do the trick. The flashing rate is determined by the values of R and C.

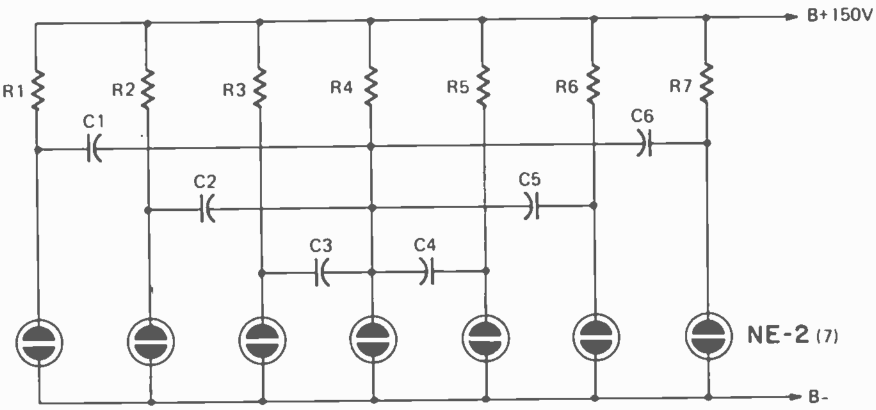
More on the unusual superregenerator

In October 1969 we described an unusual superregenerative receiver developed by Ted Hart. The receiver uses a multivibrator quench-frequency oscillator for a crystal-controlled vhf oscillator. A couple of months earlier (August, 1969, page 48) Frank Tooker described a novel square-wave generator using a pair of FET's connected as a multivibrator.

Charles Derven, of Poultney, Vt., has come up with an FET version of Ted Hart's superregenerator using 2N3819 FET's (see Fig. 2). Coil L1 consists of 32 turns of No. 26 enameled wire closewound on a ¼-inch plastic soda straw (an idea copied from I. Queen's "Pocket VHF Receiver", January 1961 issue). L2 consists of 3 turns wound around the B+ end of L1. The tuning capacitor was made by removing all except four rotor and four stator plates from an inexpensive 365-pF tuning capacitor.

Mr. Derven reports receiving several Latin-American stations while using a 36-inch whip antenna. He added that tuning was critical and the smooth hiss indicating superrengeneration could be obtained only when the tuning capacitor was nearly wide open. Closing the capacitor further caused the circuit to whistle.

(It sounds like this circuit now



R1 - R7 = 220K to 2.2 MEGS
C1 - C6 = 0.1 to 1 μF LOW LEAKAGE TYPE

FIG. 1—RANDOM-ORDER FLASHER is a group of neon lamps interlocked as multivibrators. It can be used as a highway obstruction marker, docking beacon or do-nothing toy for tots.

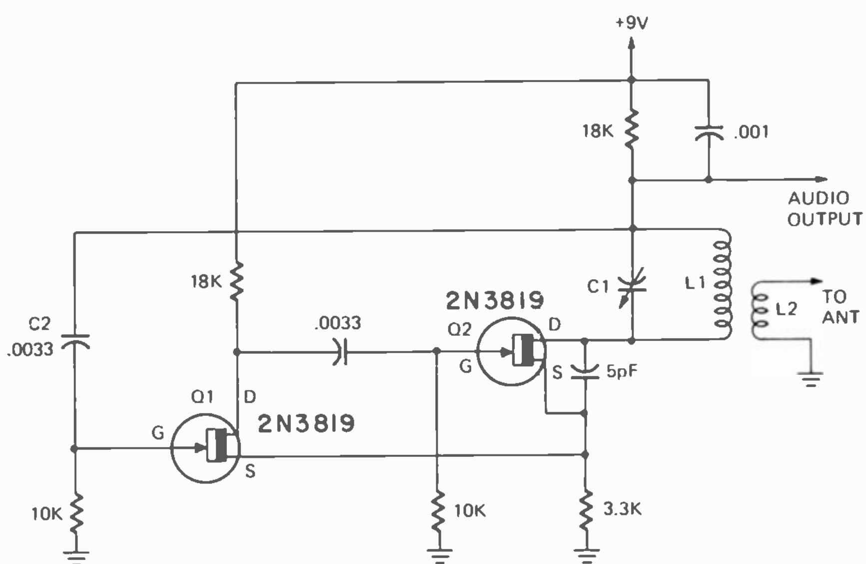


FIG. 2—UNUSUAL SUPERREGENERATIVE DETECTOR uses FET's connected as multivibrator quench oscillator. Designer reports receiving South American shortwave stations.

needs a regeneration control. One possible way is to try replacing C2 with a variable capacitor of much lower capacitance, say 365 pF. Another possible approach is to feed the gate of Q1 from a tertiary coil of a few turns around L1. One end of the coil would be grounded or returned to ground through a variable capacitor. The other end goes to Q1 through C2.)

Power supply hang up

A reader in Crescenta, Calif.–his signature was not clear–ran into trouble when he decided to modify his bench power supply along the lines of the dual supply in the November 1972 issue. He found the CA3055 IC had been discontinued and replaced by the CA3085A and CA3085B IC's.

He used the 5.6-ohm resistor between pins 1 and 8 as specified in the CA3085 data sheets instead of the 45-ohm resistor and 1000-ohm pot combination used in the original dual power supply. He reports that the supply works quite well. A TO-5 type heatsink on the IC keeps it close to room temperature.

Sensitive squelch circuit

The squelch circuit in Fig. 3 can be added to most FM monitor receivers. It is used in Zenith's RD52 AM-FM receiver. The circuit is switched into operation when the bandswitch is set to the PS (public service) position for receiving transmissions from U.S. Weather Service, fire, police, public utilities and other services operating between 148 and 174 MHz.

Transistors Q1 and Q2 form the carrier-operated circuit that controls conduction through Q3, the audio preamplifier and switch used for public-service audio. When Q3 turned off, it mutes the receiver; when this transistor is turned on, it amplifies the incoming audio signal.

When the SQUELCH control arm is advanced toward the B- end, a point is reached where Q1 is biased to cutoff and Q2 is biased on. The voltage on Q2's collector is transferred through D3 to Q3's base, turning off the audio and efficiently silencing the receiver.

When an incoming signal appears at the collector of the i.f. output stage, a portion is applied to a voltage doubler consisting of D1 and D2. The voltage-doubler output develops across C3 and is applied to the base of Q1 through the 1000-ohm decoupling resistor. When the voltage is high enough to over-ride the fixed cutoff bias from the SQUELCH control, Q1 turns on, Q2 is turned off and Q3 turns on, thereby passing the audio signal through the bandswitch to the volume control and the balance of the audio circuits.

Shorted-turns tester

Shorted turns in a TV flyback transformer, deflection yoke, width coil or other inductors in the deflection circuit can produce annoying symptoms that can be difficult to track down. This is particularly true when the shorted condition does not cause charring or overheating that can be detected easily by sight or smell.

The shorted-turn detector in Fig. 4, described originally in *Electronics Australia*, can be tucked into the tube caddy so coils with shorted turns can be isolated and replaced without having to pull the set to the shop for service.

Q1 is a Colpitts oscillator using a standard horizontal "ringing" or "sine-wave" coil. Q2 is a transistor voltmeter that monitors the oscillator output. The 470-ohm emitter resistor was selected to limit current through the meter to less than 1 mA when the oscillator is developing maximum output–the 1000-ohm pot will be set for minimum resistance.

When the device is first turned on the meter reads around 0.1 mA, indicating that the oscillator is not operating. As the pot resistance is reduced, the oscillator starts operating and the meter reading jumps to about 0.4 mA. Shorting the test leads causes the meter reading to drop; indicating that the oscillator has been loaded down and has stopped oscillating.

To test a suspected inductor or transformer, set the pot so the meter reads about 0.6 mA and then connect the test leads. With this level of activity, the oscillator will not be affected by a high-impedance shunting the coil under test but will show up a shorted turn or a low-impedance shunt path in the circuit.

Familiarize yourself with the tester by checking the windings of a good flyback and then, with the test leads across one winding, thread a short piece of wire around the core and connect the ends together and watch the meter. You should easily perceive the difference.

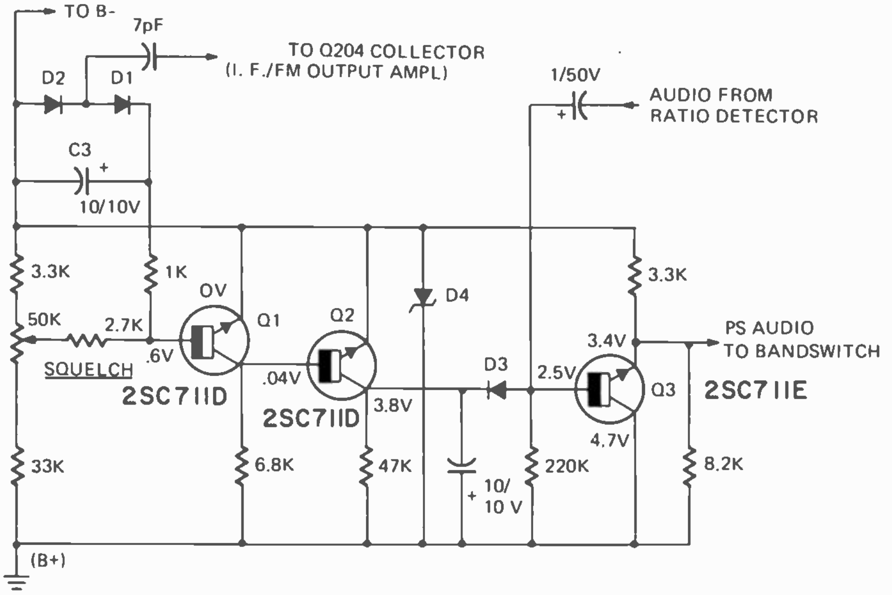


FIG. 3—EFFECTIVE SQUELCH CIRCUIT is from Zenith's RD52 receiver. Circuit cuts in automatically when receiver bandswitch is set for monitoring the 148–175-MHz range.

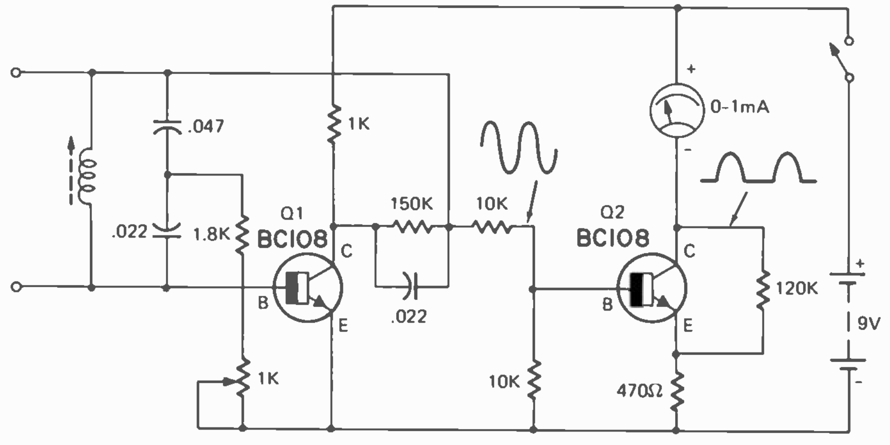


FIG. 4—SHORTED TURNS IN TV INDUCTORS are easy to locate with this tester. Oscillator is loaded down so meter reading drops when shunted by coil or transformer with shorted turns.

Simple FET voltmeter

The voltmeter in Fig. 5 was taken from a Mullard *Educational Projects in Electronics* booklet. Input resistance is at least 10 megohms on its eight dc voltage ranges. It uses an N-channel FET operating as a source follower. The voltage being measured is applied across the voltage divider consisting of 10 megohms in series with a shunt resistance—selected by the RANGE switch—between the FET gate and ground. The shunt resistance selected is such that the voltage between FET gate and ground is 200 mV for full-scale voltage on all ranges. The inherent high input resistance of the FET and the negative feedback across the unbypassed source resistor insure that there is never less than 10 megohms in parallel with lower end of the input voltage divider, even on the lowest range.

Potentiometer R24 sets full-scale deflection on the 250-mV range and compensates for the difference in transfer conductance—roughly gain—of different FET's. All other ranges are adjusted for full-scale deflection by using the preset potentiometers in series with the shunt leg of the input voltage dividers. The 250-ohm wirewound [zero adjust] pot is mounted on the front panel and used to zero the meter with the input leads shorted.

The FET voltmeter can be calibrated using an adjustable power supply and a vtvm or digital voltmeter across the FET meter's input terminals or by using the scheme in Fig. 6. With this setup, a dc microammeter measures the current through R2, a precision resistor. The voltage applied to the FET is then R2 x I. The calibration procedure:

1. Switch to the 250-mV range, set R24 for *minimum* resistance. Short the input terminals together and use R26 to zero the meter. Remove the short from the input terminals.

2. Apply 250 mV to the input and adjust for full-scale deflection.

3. Repeat steps 1 and 2 until the meter reads correctly at zero and full-scale.

4. Switch to the 500-mV range, short the input terminals and check for zero deflection on the meter. If not, repeat steps 1 and 2. Remove the short, apply 500 mV to the input and adjust R8 for full-scale. Do not adjust R24.

5. Switch to the other ranges and apply full-scale voltages to the input and adjust R11, R16, R18, R20 and R22 for full-scale deflection on the appropriate range.

Battery isolation scheme

A ham reader asked for a circuit that would permit him to add a second battery to his car. The auxiliary battery is for operating only the 2-way radio equipment. Both batteries are to be charged from the car's generator or alternator.

Digging into my files, I came up with the circuit in Fig. 7. It appeared in *Electronics Australia.* In this case, four 25-ampere silicon diodes of the type used in automobile alternators are used to isolate the two batteries.

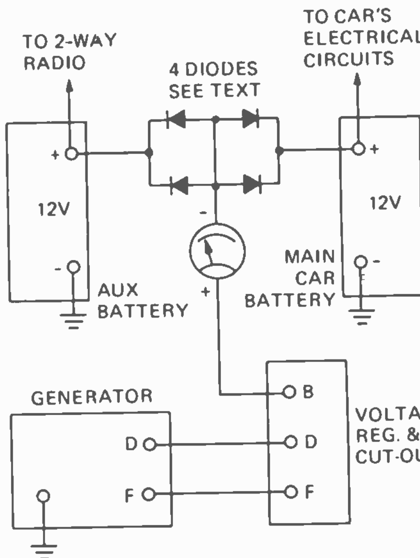


FIG. 7—DUAL BATTERIES in car with 2-way radio insure more reliable radio operation and quick and easy starting.

The diodes are Mullard BYX21-200R's (the "R" suffix indicates reverse polarity—the *anode* is connected to the case) pressed into a 6-inch length of Mullard type 35D6C heatsink. The heatsink itself is used as the common anode connection. Equivalent silicon diodes are the HEP R0222-R and similar types. If a suitable heat sink is not available, use stud-mount diodes.

Well that's it for now. Keep those cards and letters coming. Give me an idea as to how much text is needed with the average diagram. The space allotted for Tech Topics is limited so if we can cut down a little on text we can squeeze in an extra diagram or two. But, remember that this may mean cutting down on the construction tips, calibration aids and "how-it-works" dope that I've been including. Let's hear from you. **R-E**

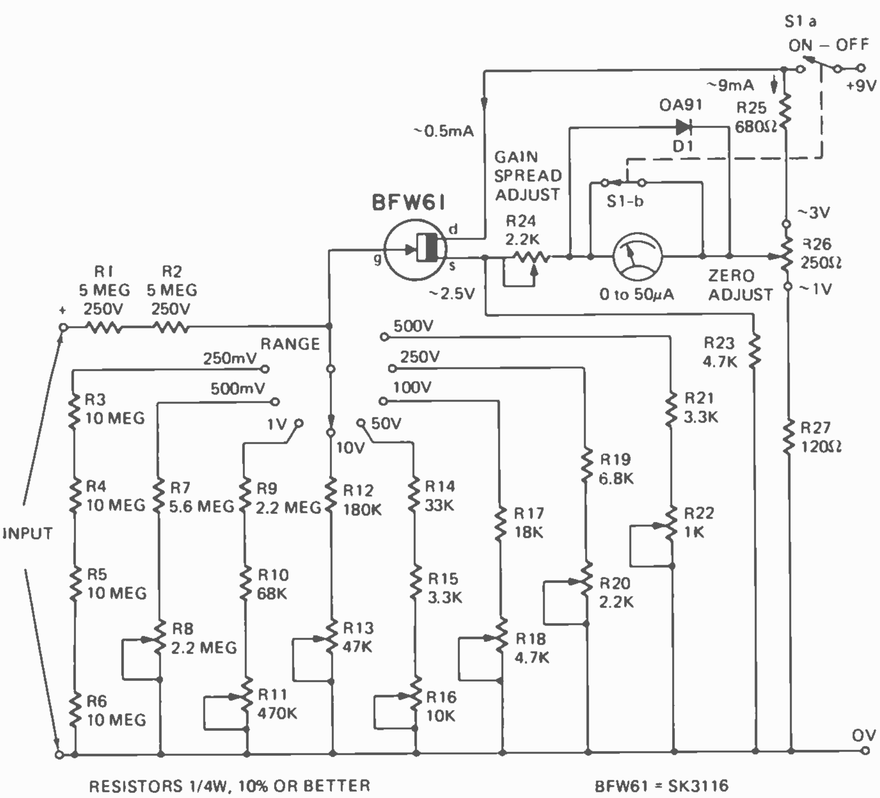


FIG. 5—DC VOLTMETER USES FET to give it a very high input impedance on its eight dc ranges. Construction and calibration are simple and straightforward.

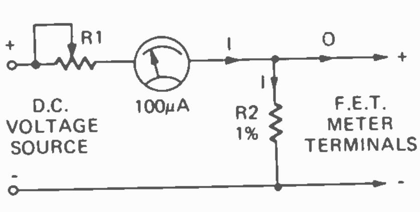


FIG. 6—METER CALIBRATOR develops reference voltage by controlling the current flowing through a precision resistor.

NEXT MONTH

Three special articles highlight developments in solid-state electronics. We start with an article on a new kind of color TV that has special circuit features we know you want to read about. Then Don Lancaster explores the world of the ROM (Read Only Memory). Last, there's an IC Gyrator—that's a device that behaves like an inductor but has no coil. Don't miss the February issue.

Step-by-step TV Troubleshooters Guide

by STAN PRENTISS

IF DRS. BRATTAIN, BARDEEN, AND Shockley had to sit down and troubleshoot some of our modern communications equipment, they might have momentary second thoughts about their invention of the transistor in 1947. For in 1973, solid-state engineering of consumer electronics is complex indeed. Take, for instance, the switched low-voltage power supply. Motorola had its TS-938 over two years ago (June 1971). Zenith followed with their EC45, EC58 series with loosely wound primary-secondary coils, where the secondary is shunted by several microfarads of capacitance and core-saturated. It regulates respectably from about 95 to 135 or so volts ac and maintains short-circuit resistance for 10 or more seconds before popping the circuit breaker.

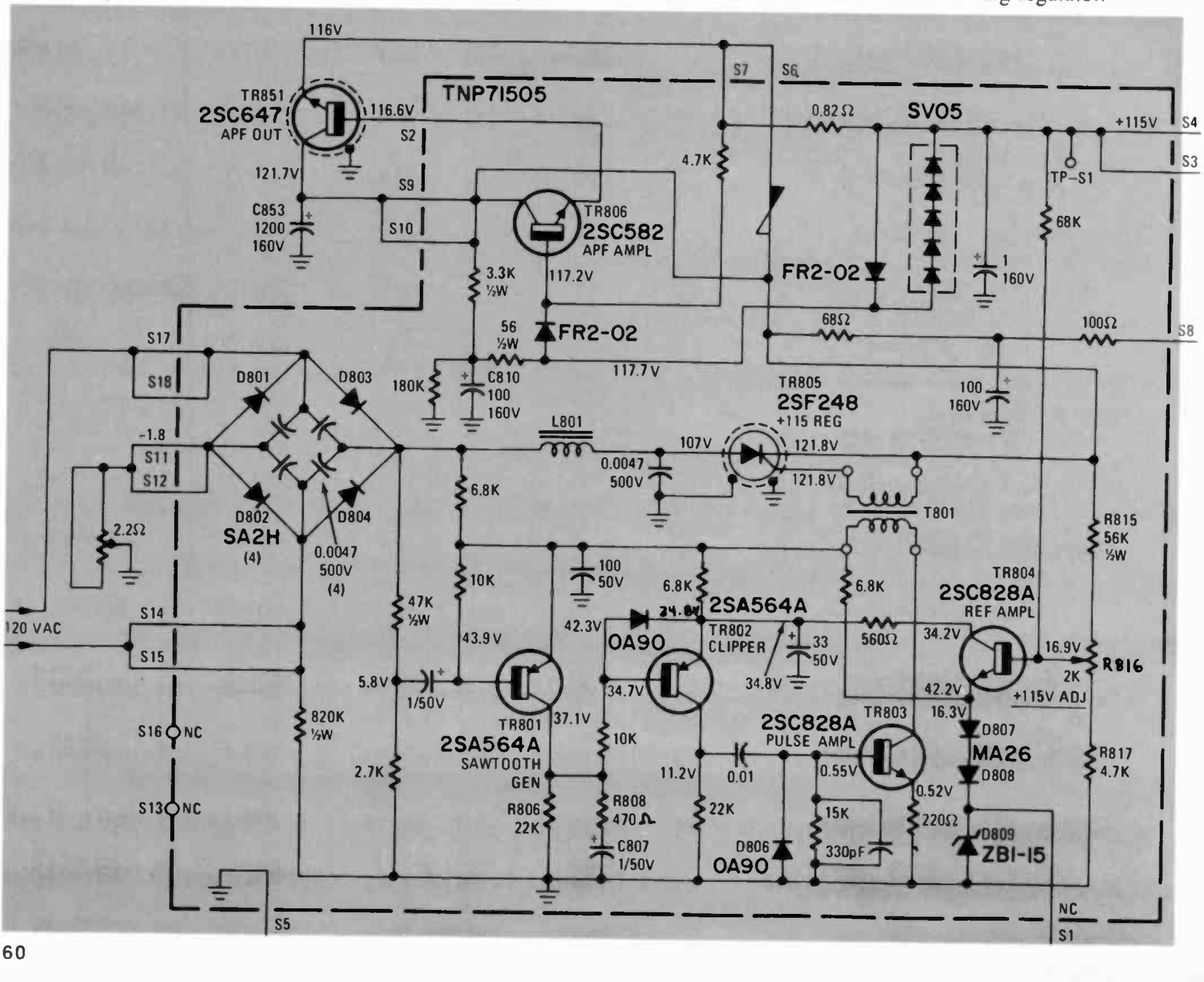
The switched power supplies may not have quite the broad voltage range of the capacitor-shunted secondary types, but their regulation will be somewhat more precise. This year both U.S. and Japanese appear to be moving towards such low-voltage sources.

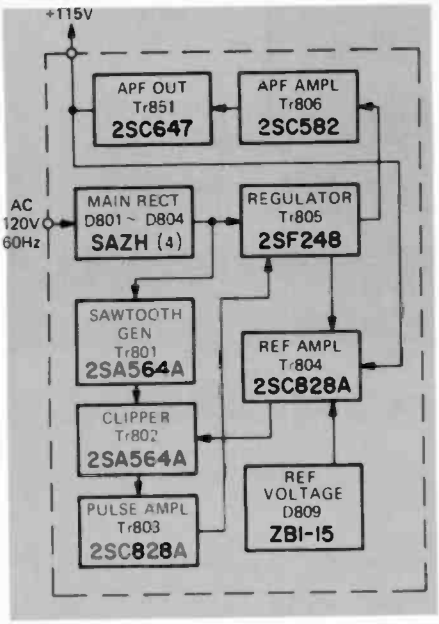
How about the service technician? What does he do when there's power but no high voltage; no high voltage and no power; sound and no high voltage; set blows fuses; power is applied and smoke spirals? Suppose, for instance, you have problems with the newest Panasonic or Sony? Delivering the same end product, in design and execution you'll find them totally different.

Panasonic ETA-2 Chassis

This is a modern group of 19 and 25-inch receivers (models CT-701, CT-252 through CT-254) with an almost completely modularized chassis—six major plug boards, and more, plus 40 transistors, six integrated circuits and 51 diodes. IC's include aft, sound detection and amplification, color processor, subcarrier regenerator, and chroma demodulator; as well as a video jungle circuit containing agc, noise canceller, abl (automatic brightness limiter), sync separator, and 1st video amplifier. The power supply "S" board is a plug-in on the right wing (next to the high voltage), while all signal and sync circuits are on the left. The block diagram in Fig. 1, along with the schematic of Fig. 2, shows the signal flow.

The bridge rectifier (D801 through D804) picks up incoming ac from the power line. The pulsating dc output of the rectifier is smoothed by filter choke L801 to some extent for the 115-V switching regulator.





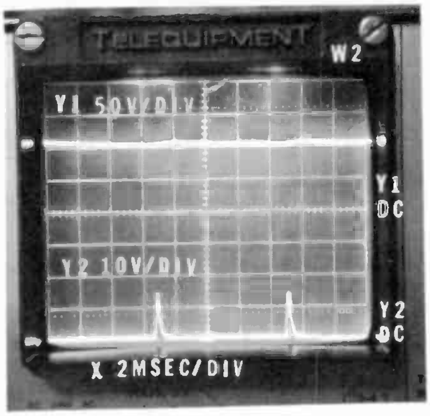
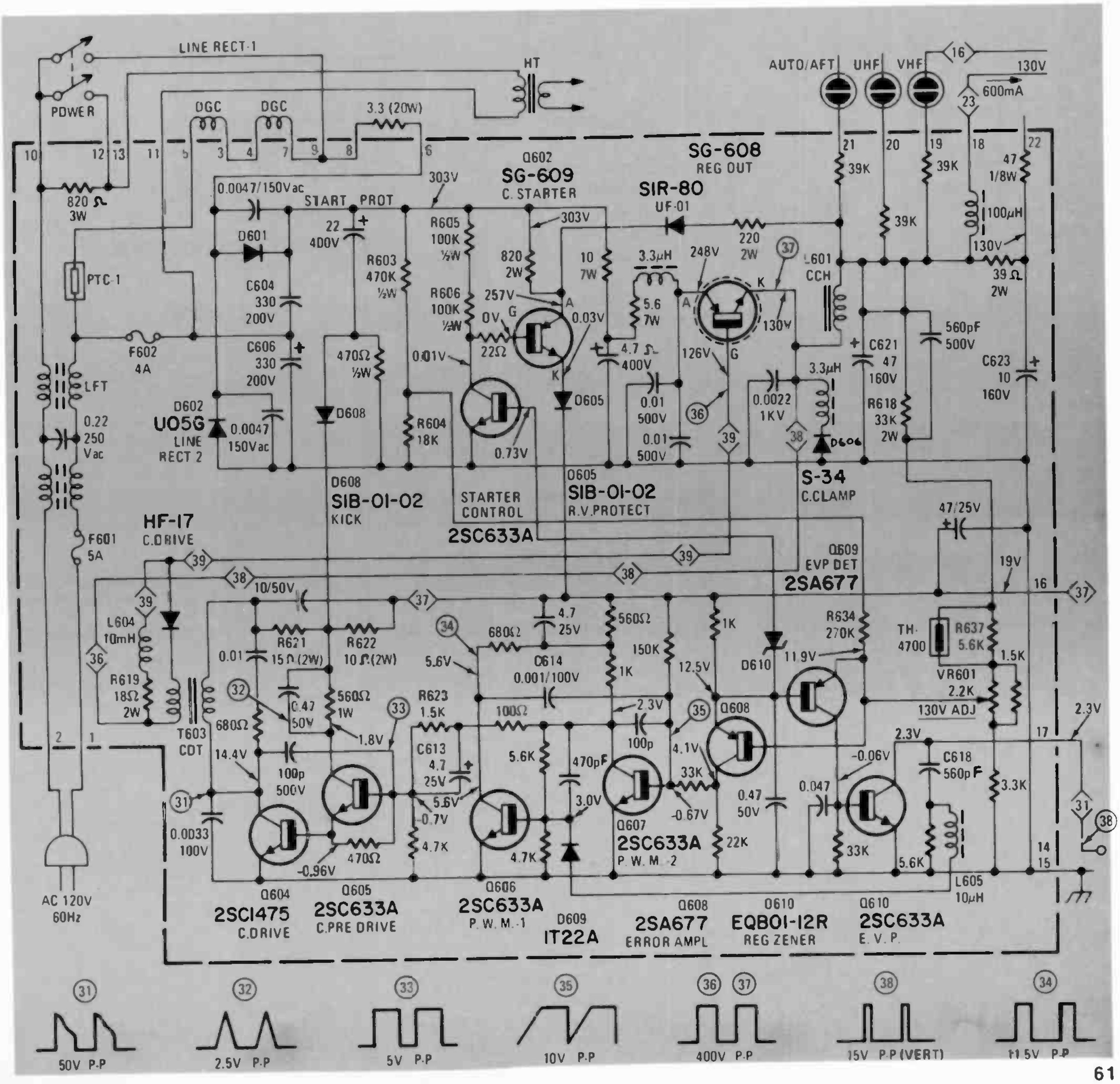
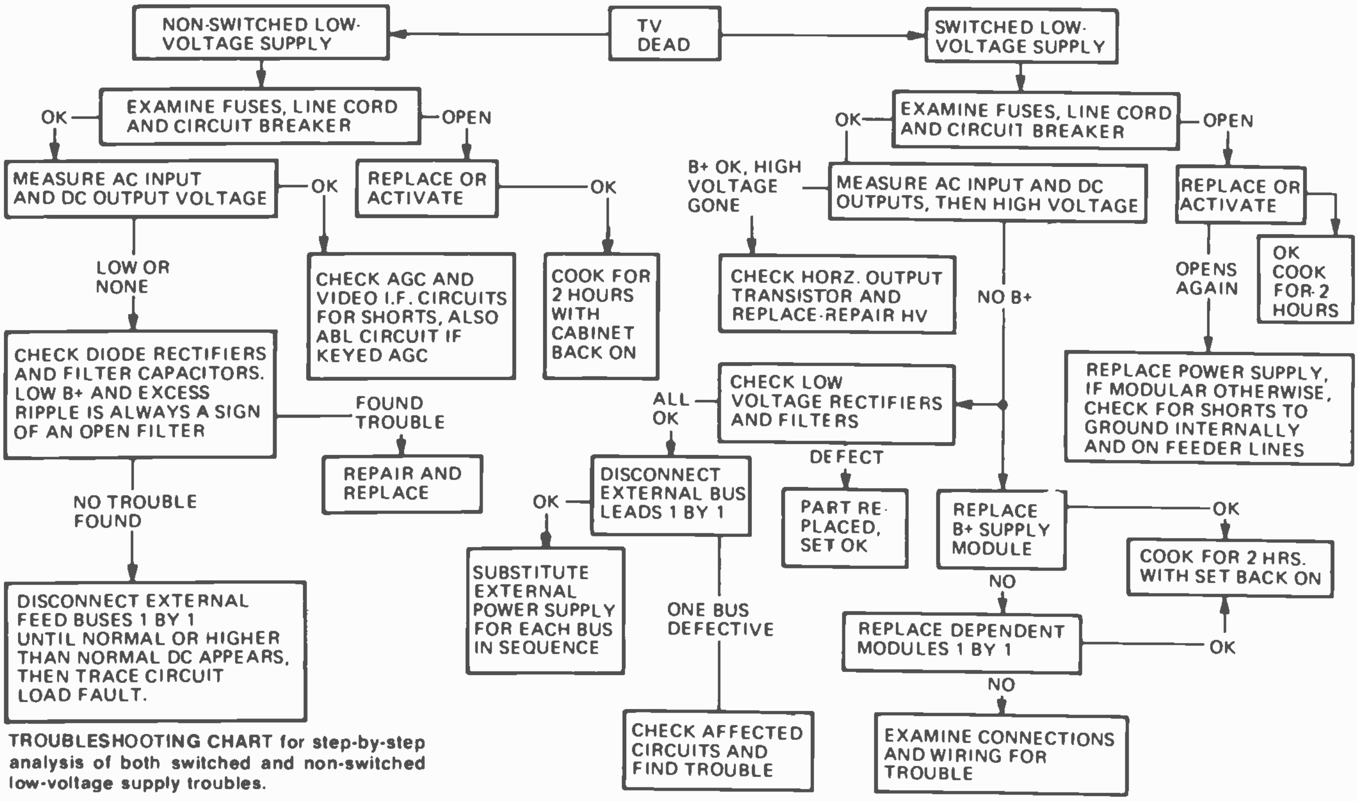


FIG. 1 (left)—BLOCK DIAGRAM shows signal flow in the low-voltage power supply in Panasonic's ETA-2 chassis. POWER SUPPLY SCHEMATIC (FIG. 2, on previous page) shows circuit complexity. FIG. 3 (above)—Y1 and Y2 are anode and cathode waveforms, respectively, of TR805 in Fig. 1. FIG. 4 (below)—SONY'S SWITCHED SUPPLY.

At 140 V p-p, this same waveform also couples through saw-tooth generator TR801, is inverted and converted to a sawtooth by R806, R808, and C807 whose inverted p-p voltage is now only 12. TR802 now does some clipping, while pulse amplifier TR803 again inverts the D806-clamped waveform and puts it through transformer T801 as a trigger pulse. This transformer triggers the SCR gate for longer or shorter periods so its current and voltage develop the necessary 115-V regulated output. Active power filters (apf) TR806 and TR851 now take over and complete the dc smoothing operation, along with large filters C810 and C853. Overall filter action for this power supply, then, is the beta of the transistors times the filter capacitance—forming a powerfully active filter indeed.

Regulating action for Panasonic's





TROUBLESHOOTING CHART for step-by-step analysis of both switched and non-switched low-voltage supply troubles.

supply is generated by feedback through divider resistors R815, R817, and +115-V adjust R816. TR804 establishes a reference through Zener D809 and temperature compensation diodes D807 and D808. Changes in output voltage induce TR804 to conduct proportionately, driving clipper TR802 more or less and delaying or expanding the drive waveform's duration through pulse amplifier TR803, producing greater or smaller output potentials through the TR805 115-V regulator. Fig. 3 shows the waveforms at two points in the circuit.

Sony KV-1722

Sony's new receiver (Fig. 4) is a 17-inch, 114-degree deflection Trinitron type in a compact cabinet with six IC's, 26 transistors, 33 diodes, and three gate controlled switches (GCS's) in the power supply and horizontal output—and *don't* forget them. The IC's include aft, sound if., demodulation, and amplification; the complete video i.f., detector, sound detector and driver, automatic noise canceller (anc), i.f. and rf agc and video drive; complete subcarrier regenerator with automatic color killer (ack), automatic chroma control (acc), burst amplifier, color and hue amplifiers, and 3.579,545-MHz color sync oscillator; the chroma demodulator with sharpness acr, a luminance amplifier, and blanker; and a deflection chip with sync amplifier, afc gate, horizontal oscillator and protect circuit, vertical oscillator, buffer, and horizontal pre-amplifier.

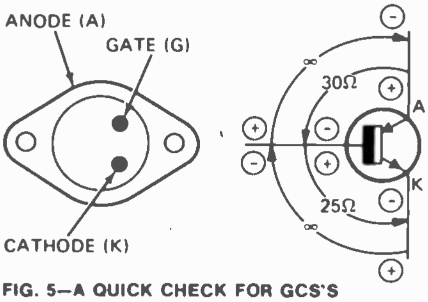


FIG. 5—A QUICK CHECK FOR GCS'S

The power supply—in which we're interested—is a separate board mounted on the back of the receiver with one ac (F601) and one dc (F602) fuse between the entire receiver and its power line. D601 and D602 are full-wave doubler rectifiers that alternately charge C604, and C606, so that output is 310 V (303 V loaded) of relatively smooth dc. D608 is now ready to protect against too much sudden voltage at the junction of R621 and R622, and GCS starter Q602 now becomes active through divider resistors R605 and R606. This gated switch conducts momentarily through D605, supplying immediate dc for the collectors of the entire group of current drivers, pulse-width modulators, and error-evp (excess voltage protector) detectors and amplifiers plus vertical and horizontal circuits as well. Both the horizontal oscillator and outputs now start and the regular 19-V supply kicks in through the 19-V rectifier connected to a winding of the horizontal output transformer. Zener D610 then conducts and turns on Q610

(continued on page 76)

R-E's Substitution guide for replacement transistors

PART XI

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

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	ARCH	DM	G-E	ICC	IR	MAL	MOT	RCA	SPR	SYL	ZEN
2N2402	RS276-2003	T-3	GE-9	ICC-3	NA	PTC 102	HEP-3	NA	NA	ECG 160	ZEN 301
2N2403	NA	NA	GE-63	NA	NA	PTC 144	HEP-S3001	NA	NA	NA	NA
2N2404	NA	NA	GE-63	NA	TR-25	PTC 144	HEP-S3011	NA	NA	NA	NA
2N2405	NA	T-714	GE-27	ICC-714	NA	PTC 144	HEP-714	SK 3024	RT-114	ECG 128	NA
2N2406	NA	T-251	GE-52	NA	TR-05	PTC 102	NA	SK 3123	NA	NA	NA
2N2410	NA	TS-3001	GE-63	NA	IRTR-65	PTC 144	HEP-S3001	NA	NA	NA	
2N2411	RS276-2023	T-52	GE-22	ICC-52	TR-19	PTC 103	HEP-52	SK 3114	RT-115	ECG 159	NA
2N2412	RS276-2023	T-52	GE-22	ICC-52	TR-30	PTC 103	HEP-52	SK 3114	RT-115	ECG 159	NA
2N2413	RS276-2009	T-50	GE-20	ICC-50	TR-51	PTC 136	HEP-50	SK 3122	RT-102	ECG 123A	NA
2N2414	NA	NA	NA	NA	NA	NA	HEP-S0004	NA	NA	NA	ZEN 100 NA
2N2415	RS276-2003	T-3	GE-51	ICC-3	TR-17	PTC 107	HEP-3	NA	NA	ECG 160	ZEN 301
2N2416	RS276-2003	T-3	GE-51	ICC-3	TR-17	PTC 107	HEP-3	NA	NA	ECG 160	ZEN 301
2N2417	NA	T-736	NA	NA	TR-25	NA	NA	SK 3124	NA	ECG 123A	NA
2N2418	NA	NA	NA	NA	NA	NA	HEP-310	NA	NA	NA	NA
2N2419	NA	NA	NA	NA	NA	NA	HEP-310	NA	NA	NA	NA
2N2420	NA	NA	NA	NA	NA	NA	HEP-310	NA	NA	NA	NA
2N2421	NA	NA	NA	NA	NA	NA	HEP-310	NA	NA	NA	NA
2N2422	NA	NA	NA	NA	NA	NA	HEP-310	NA	NA	NA	NA
2N2423	RS276-2006	T-232	GE-16	ICC-232	TR-01	NA	HEP-232	SK 3009	RT-127	NA	ZEN 326
2N2424	RS276-2021	T-51	GE-21	ICC-51	NA	PTC 103	HEP-51	SK 3114	RT-115	ECG 121	ZEN 101
2N2425	RS276-2021	T-51	GE-21	ICC-51	TR-28	PTC 103	HEP-51	SK 3114	RT-115	ECG 159	ZEN 101
2N2426	RS276-2002	T-641	GE-54	ICC-641	TR-10	PTC 108	HEP-641	SK 3011	RT-119	ECG 159	ZEN 315
2N2427	RS276-2009	T-50	GE-21	ICC-50	IRTR-51	PTC 121	HEP-50	SK 3122	RT-102	ECG 101	ZEN 100
2N2428	RS276-2005	T-251	GE-52	ICC-251	IRTR-85	PTC 135	HEP-251	SK 3004	RT-121	ECG 123A	ZEN 303
2N2429	RS276-2004	T-253	GE-53	ICC-253	IRTR-85	PTC 135	HEP-253	SK 3004	RT-121	ECG 102A	ZEN 304
2N2430	RS276-2001	T-641	GE-59	ICC-641	TR-09	PTC 108	HEP-641	SK 3010	RT-122	ECG 102A	ZEN 315
2N2431	RS276-2006	T-238	GE-53	ICC-238	TR-14	PTC 109	HEP-238	SK 3004	NA	ECG 103A	ZEN 329
2N2432	RS276-2009	T-50	GE-62	ICC-50	IRTR-51	PTC 139	HEP-50	SK 3122	RT-102	ECG 158	ZEN 100
2N2433	NA	T-706	GE-27	NA	IRTR-87	PTC 144	HEP-S3020	NA	NA	ECG 123A	NA
2N2434	NA	NA	NA	NA	IRTR-87	NA	HEP-S3020	NA	NA	NA	NA
2N2435	NA	T-706	GE-27	NA	IRTR-87	PTC 144	HEP-714	NA	NA	NA	NA
2N2436	NA	NA	NA	NA	IRTR-87	NA	HEP-714	NA	NA	NA	NA
2N2437	NA	T-706	GE-27	NA	IRTR-87	PTC 144	HEP-714	NA	NA	NA	NA
2N2438	NA	T-706	GE-27	NA	IRTR-87	PTC 144	HEP-714	NA	NA	NA	NA
2N2439	NA	T-706	GE-27	NA	IRTR-78	NA	HEP-714	NA	NA	NA	NA
2N2440	NA	NA	NA	NA	NA	NA	HEP-714	NA	NA	NA	NA
2N2443	NA	T-706	GE-27	NA	IRTR-78	PTC 125	HEP-713	NA	NA	NA	NA
2N2444	NA	NA	NA	NA	NA	NA	HEP-626	NA	NA	NA	NA
2N2445	NA	NA	NA	NA	NA	NA	HEP-236	NA	NA	NA	NA
2N2446	RS276-2006	T-232	GE-16	ICC-232	TR-01	NA	HEP-232	SK 3009	RT-127	ECG 121	ZEN 326
2N2447	RS276-2007	T-631	GE-2	ICC-631	IRTR-85	PTC 102	HEP-631	SK 3004	RT-121	ECG 102A	ZEN 307
2N2448	RS276-2007	T-631	GE-2	ICC-631	IRTR-85	PTC 109	HEP-631	SK 3004	RT-121	ECG 102A	ZEN 307
2N2449	RS276-2003	T-633	GE-53	ICC-633	IRTR-85	PTC 109	HEP-633	SK 3004	RT-121	ECG 102A	ZEN 309
2N2450	RS276-2003	T-633	GE-53	ICC-633	IRTR-85	PTC 109	HEP-633	SK 3004	RT-121	ECG 102A	ZEN 309
2N2451	RS276-2003	T-3	GE-51	ICC-3	TR-12	PTC 107	HEP-3	SK 3006	NA	ECG 126	ZEN 301
2N2453	NA	NA	NA	NA	NA	NA	HEP-S0007	NA	NA	NA	NA
2N2454	NA	NA	NA	NA	NA	NA	HEP-R1245	NA	NA	NA	NA
2N2455	NA	T-2	GE-9	ICC-2	TR-17	NA	HEP-2	NA	NA	ECG 160	ZEN 300
2N2456	RS276-2003	T-2	GE-9	ICC-3	TR-12	NA	HEP-3	NA	NA	ECG 126	ZEN 301
2N2459	NA	NA	NA	NA	NA	PTC 123	HEP-S0005	NA	NA	NA	NA
2N2460	NA	NA	NA	NA	NA	PTC 123	HEP-S0005	NA	NA	NA	NA
2N2461	NA	NA	NA	NA	NA	NA	HEP-S0005	NA	NA	NA	NA
2N2462	NA	NA	NA	NA	NA	NA	HEP-S0005	NA	NA	NA	NA
2N2463	NA	T-706	GE-27	NA	NA	PTC 123	HEP-S0005	NA	NA	NA	NA
2N2464	NA	NA	NA	NA	NA	PTC 123	HEP-S0005	NA	NA	NA	NA
2N2465	NA	NA	GE-54	NA	NA	NA	HEP-S0001	NA	NA	NA	NA
2N2466	RS276-2009	T-50	NA	ICC-50	NA	NA	HEP-50	SK 3122	RT-102	ECG 123A	ZEN 100
2N2467	RS276-2006	T-238	NA	ICC-238	NA	NA	HEP-238	NA	NA	NA	ZEN 129
2N2468	NA	T-251	GE-51	NA	TR-05	PTC 102	HEP-239	SK 3004	RT-120	ECG 102	NA
2N2469	NA	T-250	GE-2	NA	NA	PTC 102	NA	SK 3004	RT-120	ECG 102	NA
2N2472	NA	T-247	GE-20	NA	NA	PTC 144	HEP-714	NA	NA	NA	NA
2N2473	NA	T-247	GE-20	NA	NA	PTC 144	HEP-714	NA	NA	NA	NA
2N2474	NA	T-51	GE-21	NA	TR-30	PTC 131	NA	NA	NA	NA	NA
2N2475	RS276-2011	T-56	GE-61	ICC-56	NA	PTC 126	HEP-56	NA	NA	NA	ZEN 104
2N2476	RS276-2009	T-53	GE-18	ICC-53	IRTR-62	PTC 136	HEP-53	SK 3122	RT-102	ECG 123A	ZEN 102
2N2477	RS276-2009	T-53	GE-18	ICC-53	IRTR-62	PTC 136	HEP-53	SK 3122	RT-102	ECG 123A	ZEN 102
2N2478	NA	T-714	GE-18	NA	NA	NA	HEP-714	NA	NA	NA	NA
2N2479	NA	T-714	GE-18	NA	NA	PTC 144	HEP-S3011	NA	NA	NA	NA
282480*	NA	NA	NA	NA	NA	NA	HEP-S0005	NA	NA	NA	NA
2N2481	RS276-2009	T-50	GE-20	ICC-50	IRTR-21	PTC 136	HEP-50	SK 3122	RT-102	ECG 123A	ZEN 100

NA=NOT AVAILABLE

(turn page)

	ARCH	DM	G-E	ICC	IR	MAL	MOT	RCA	SPR	SYL	ZEN
2N2482	RS276-2002	T-641	GE-54	ICC-641	TR-08	PTC 108	HEP-641	SK 3010	RT-122	ECG 103	ZEN 315
2N2483	RS276-2009	T-50	GE-18	ICC-729	IRTR-51	PTC 121	HEP-729	SK 3122	RT-102	ECG 123A	ZEN 115
2N2484	RS276-2009	T-50	GE-63	ICC-S0007	IRTR-21	PTC 121	HEP-S0007	SK 3122	RT-102	ECG 123A	NA
2N2487	RS276-2003	T-3	GE-9	ICC-3	NA	PTC 107	HEP-3	SK 3006	NA	ECG 126	ZEN 301
2N2488	RS276-2003	T-3	GE-9	ICC-3	NA	PTC 107	HEP-3	SK 3006	NA	ECG 126	ZEN 301
2N2489	RS276-2003	T-3	GE-9	ICC-3	NA	PTC 107	HEP-3	SK 3006	NA	ECG 126	ZEN 301
2N2490	NA	T-233	GE-4	ICC-233	NA	PTC 106	HEP-233	SK 3012	NA	ECG 105	ZEN 327
2N2491	NA	T-233	GE-4	ICC-233	NA	PTC 106	HEP-233	SK 3012	NA	ECG 105	ZEN 327
2N2492	NA	T-233	GE-4	ICC-233	NA	PTC 106	HEP-233	SK 3012	NA	ECG 105	ZEN 327
2N2493	NA	T-233	GE-4	ICC-233	NA	PTC 106	HEP-233	SK 3012	NA	ECG 105	ZEN 327
2N2494	RS276-2003	T-3	GE-9	ICC-3	NA	PTC 135	HEP-3	SK 3006	NA	ECG 126	ZEN 301
2N2495	NA	T-2	GE-9	ICC-2	NA	PTC 107	HEP-2	SK 3006	NA	ECG 160	ZEN 300
2N2496	NA	T-2	GE-9	ICC-2	NA	PTC 107	HEP-2	SK 3006	NA	ECG 160	ZEN 300
2N2497	NA	NA	NA	NA	NA	NA	HEP-803	NA	NA	NA	NA
2N2498	NA	NA	NA	NA	NA	NA	HEP-803	NA	NA	NA	NA
2N2499	NA	NA	NA	NA	NA	NA	HEP-803	NA	NA	NA	NA
2N2500	NA	NA	NA	NA	NA	NA	HEP-803	NA	NA	NA	NA
2N2501	RS276-2009	T-50	GE-17	ICC-50	IRTR-21	PTC 121	HEP-50	SK 3122	RT-102	ECG 123A	ZEN 100
2N2509	NA	T-714	GE-18	NA	NA	PTC 125	HEP-S0005	SK 3045	RT-110	ECG 154	NA
2N2510	NA	T-53	GE-20	NA	NA	PTC 123	HEP-S0001	SK 3045	RT-110	ECG 154	NA
2N2511	NA	T-53	GE-20	NA	NA	NA	HEP-S0001	NA	NA	NA	NA
2N2512	NA	T-636	NA	NA	TR-17	PTC 107	NA	NA	NA	ECG 160	NA
2N2514	NA	T-714	GE-18	NA	TR-25	PTC 121	HEP-S3011	NA	NA	NA	NA
2N2515	NA	NA	NA	NA	NA	PTC 121	HEP-S3011	NA	NA	NA	NA
2N2516	NA	NA	NA	NA	NA	PTC 121	HEP-S3011	NA	NA	NA	NA
2N2517	NA	T-714	GE-18	NA	NA	PTC 125	HEP-714	NA	NA	NA	NA
2N2518	NA	NA	NA	NA	NA	NA	HEP-714	NA	NA	NA	NA
2N2519	NA	NA	NA	NA	NA	NA	HEP-714	NA	NA	NA	NA
2N2520	RS276-2009	T-53	GE-18	ICC-53	IRTR-25	PTC 121	HEP-53	SK 3122	RT-102	ECG 123A	ZEN 102
2N2521	RS276-2009	T-53	GE-63	ICC-53	IRTR-25	PTC 121	HEP-53	SK 3122	RT-102	ECG 123A	ZEN 102
2N2522	RS276-2009	T-53	GE-63	ICC-53	IRTR-25	PTC 121	HEP-53	SK 3122	RT-102	ECG 123A	ZEN 102
2N2523	RS276-2009	T-53	GE-18	ICC-53	IRTR-25	PTC 121	HEP-53	SK 3122	RT-102	ECG 123A	ZEN 102
2N2524	RS276-2009	T-53	GE-63	ICC-53	IRTR-25	PTC 121	HEP-53	SK 3122	RT-102	ECG 123A	ZEN 102
2N2525	NA	NA	NA	NA	NA	NA	HEP-714	NA	NA	NA	NA
2N2526	NA	T-627	NA	ICC-627	TR-27	PTC 122	HEP-627	NA	NA	ECG 127	NA
2N2527	NA	T-234	GE-25	ICC-234	TR-27	PTC 122	HEP-234	NA	NA	ECG 127	NA
2N2528	NA	T-644	GE-25	ICC-644	TR-27	PTC 122	HEP-644	NA	NA	ECG 127	NA
2N2529	RS276-2009	T-50	GE-61	ICC-50	IRTR-51	PTC 132	HEP-50	SK 3124	RT-102	ECG 123A	ZEN 100
2N2530	RS276-2009	T-50	GE-61	ICC-50	IRTR-51	PTC 132	HEP-50	SK 3124	RT-102	ECG 123A	ZEN 100
2N2531	RS276-2009	T-50	GE-61	ICC-50	IRTR-51	PTC 132	HEP-50	SK 3124	RT-102	ECG 123A	ZEN 100
2N2532	RS276-2009	T-50	GE-61	ICC-50	IRTR-51	PTC 132	HEP-50	SK 3124	RT-102	ECG 123A	ZEN 100
2N2533	RS276-2009	T-50	GE-61	ICC-50	IRTR-51	PTC 132	HEP-50	SK 3124	RT-102	ECG 123A	ZEN 100
2N2534	RS276-2009	T-50	GE-61	ICC-50	IRTR-51	PTC 132	HEP-50	SK 3124	RT-102	ECG 123A	ZEN 100
2N2537	NA	T-714	GE-18	NA	IRTR-25	NA	HEP-S3001	NA	NA	NA	NA
2N2538	NA	T-714	GE-18	NA	IRTR-25	NA	HEP-S3001	NA	NA	NA	NA
2N2539	RS276-2009	T-50	GE-20	ICC-50	IRTR-51	PTC 136	HEP-50	SK 3122	RT-102	ECG 123A	ZEN 100
2N2540	RS276-2009	T-50	GE-20	ICC-50	IRTR-51	PTC 136	HEP-50	SK 3122	RT-102	ECG 123A	ZEN 100
2N2541	NA	T-255	GE-53	NA	NA	NA	HEP-238	NA	RT-127	ECG 176	NA
2N2551	NA	T-706	GE-27	NA	IRTR-78	PTC 117	NA	NA	NA	NA	NA
2N2564	RS276-2006	T-238	GE-3	ICC-238	NA	PTC 102	HEP-238	SK 3004	RT-120	ECG 102	ZEN 329
2N2565	RS276-2006	T-238	GE-3	ICC-238	TR-05	PTC 102	HEP-238	SK 3004	RT-120	ECG 102	ZEN 329
2N2566	NA	T-239	NA	ICC-239	NA	NA	HEP-239	NA	NA	NA	NA
2N2567	NA	T-239	NA	ICC-239	NA	NA	HEP-239	NA	NA	NA	NA
2N2569	RS276-2009	T-50	GE-62	ICC-50	IRTR-21	PTC 121	HEP-50	SK 3122	RT-102	ECG 123A	ZEN 100
2N2570	RS276-2009	T-50	GE-62	ICC-50	IRTR-21	PTC 121	HEP-50	SK 3122	RT-102	ECG 123A	ZEN 100
2N2571	RS276-2009	T-50	GE-20	ICC-50	IRTR-51	PTC 133	HEP-50	SK 3122	RT-102	ECG 123A	ZEN 100
2N2572	RS276-2009	T-50	GE-20	ICC-50	IRTR-51	PTC 133	HEP-50	SK 3122	RT-102	ECG 123A	ZEN 100
2N2586	RS276-2009	T-50	GE-17	ICC-50	IRTR-21	PTC 133	HEP-50	SK 3122	RT-102	ECG 123A	ZEN 100
2N2587	RS276-2003	T-3	GE-51	ICC-3	TR-17	PTC 107	HEP-3	NA	NA	ECG 160	ZEN 301
2N2588	NA	T-2	GE-1	NA	TR-12	PTC 109	HEP-638	NA	NA	ECG 126	NA
2N2590	NA	T-51	GE-21	NA	TR-88	PTC 127	HEP-S0005	NA	NA	NA	NA
2N2591	NA	T-51	GE-21	NA	TR-88	PTC 127	HEP-S0005	NA	NA	NA	NA
2N2592	NA	T-51	GE-21	NA	TR-88	PTC 127	HEP-S0005	NA	NA	NA	NA
2N2593	NA	T-51	GE-21	NA	NA	PTC 127	HEP-S0005	NA	NA	NA	NA
2N2594	NA	T-706	GE-27	NA	IRTR-78	PTC 144	HEP-S3011	SK 3024	NA	NA	NA
2N2595	RS276-2023	T-52	GE-21	ICC-52	TR-88	PTC 103	HEP-52	SK 3114	RT-115	ECG 159	NA
2N2596	RS276-2023	T-52	GE-21	ICC-52	TR-88	PTC 103	HEP-52	SK 3114	RT-115	ECG 159	NA
2N2597	RS276-2023	T-52	GE-21	ICC-52	TR-88	PTC 103	HEP-52	SK 3114	RT-115	ECG 159	NA
2N2598	NA	T-708	GE-21	NA	NA	PTC 127	NA	SK 3114	RT-115	ECG 159	NA
2N2599	NA	T-708	GE-21	NA	NA	PTC 127	NA	SK 3114	RT-115	ECG 159	NA

* 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)

R-E's Service Clinic

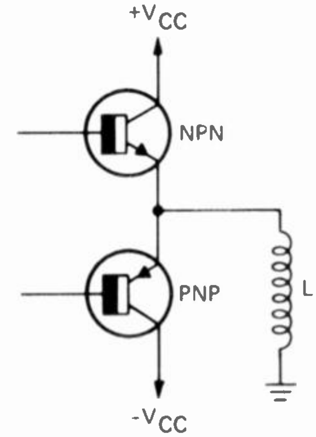
OTL Vertical Sweep

Where did the output transformer go?

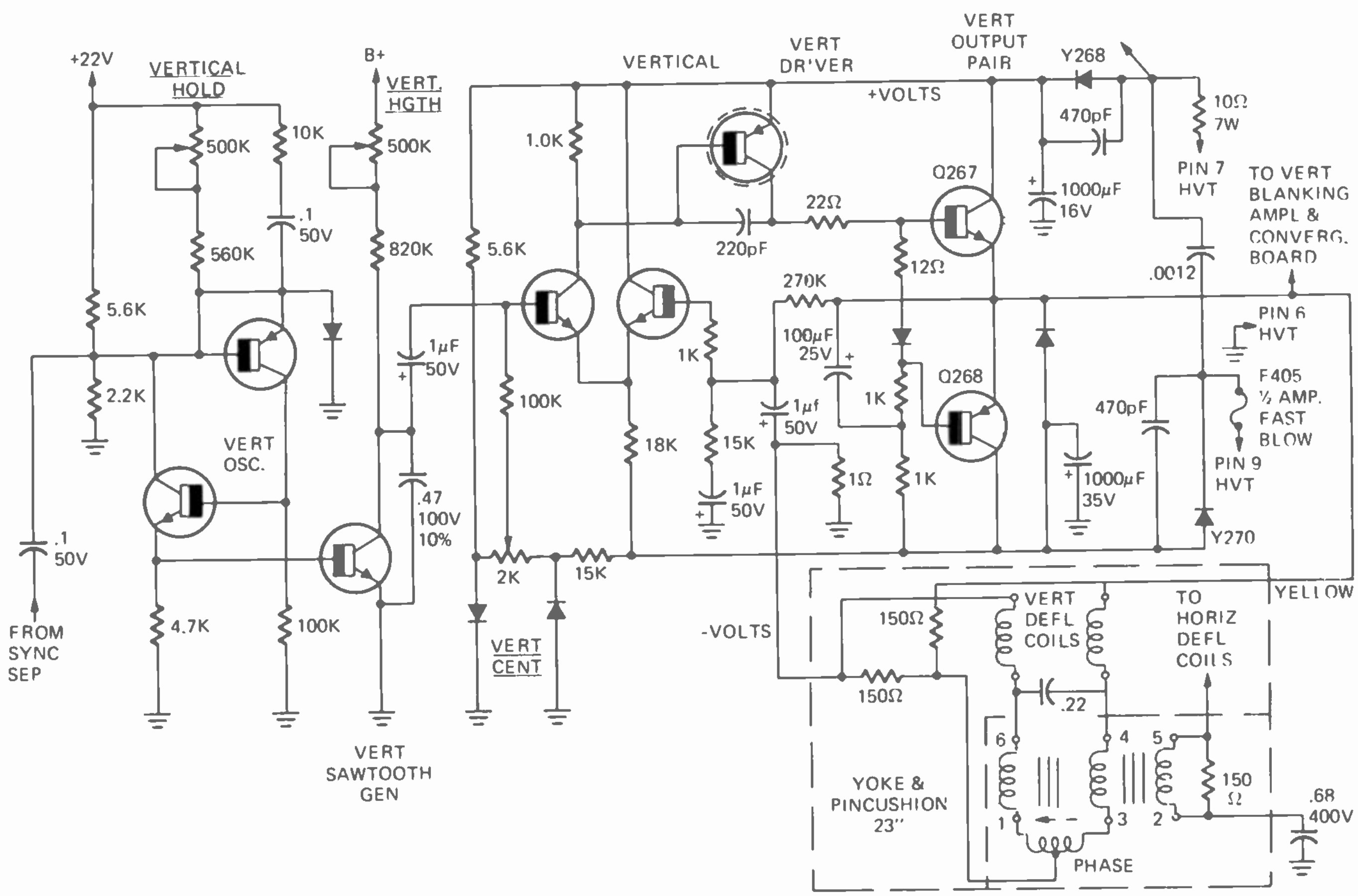
JACK DARR
SERVICE EDITOR

LOOKING INTO SOME OF THE newer solid-state TV sets, color or black/white, you might say "One of our components is missing!" It is! It's the vertical output transformer. Look at Fig. 1. What's this? The guys who say "An output transformerless audio stage" are right; the ones who said "A vertical output stage" are also right. If "L" is a speaker, audio; if "L" is the vertical windings of the deflection yoke, it's a vertical output stage, OTL, or Output TransformerLess. You'll find this in such new sets as GE's JA and MA color chassis, and others.

The theory is the same as in the audio applications. This is a push-pull output stage, identical to those used in audio amplifiers for some time. The output is taken off at the mid-point, in this case, the common emitter connection (which can lead to some dandy new symptoms.



(continued on page 70)




Wm. D
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NORRISTOWN
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FLAMELESS
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(continued on page 65)

which we'll get to in a minute).

The only difference between this and an audio amplifier is the signal input. Instead of rock music, we are dealing with a sawtooth signal, developed by an oscillator. The phase inversion needed for push-pull output is handled in a differential-pair stage, and a driver.

Some circuits use a buffer amplifier between the oscillator stage and the diff-amp stage. The output circuit here is a true complementary-symmetry type, with opposite polarity voltage supplies for the npn and pnp output transistors. So the big capacitor used in single-ended audio circuits like this isn't needed. The yoke returns to ground, usually through the pincushion corrector and a feedback network.

In the GE circuits, this feedback goes to the differential-amplifier stages, and is used to correct for any distortion in the output. A perfect sawtooth is developed, and there goes another old familiar component—the vertical linearity control. It isn't needed in this kind of circuit (and it won't be missed). Figure 2 shows the complete circuit, as used in the GE JA chassis.

Along with the new circuitry, you will see some "different" symptoms, as compared to our old "stock" vertical symptoms. For example, if you get a set with a nice linear picture, but only on the top half of the raster, or on the bottom half of the rasters, what would you say? The picture isn't compressed; half of it's not there!

This is a real dandy and it can lead us straight to the trouble. (And we love them, don't we?) In Fig. 2, if the top half of the picture is missing, Q268 is open. If the bottom half is gone, Q267 is open. Egg in your beer?

The VERTICAL CENTERING control voltage is fed to the differential-amplifier stage. So if the picture will not center properly, go straight to this stage, and make sure that it will "balance": both transistors good, etc. There is another handy trick you can use, on certain chassis. (These are the ones where the vertical output transistors are not on the vertical module itself, but on the chassis.) If you have the old familiar symptom of "Thin horizontal line—no vertical sweep", try moving the VERTICAL CENTERING control. If the line moves up and down about the right amount, the vertical *output* transistors are good. Go and look in the vertical *oscillator* stage for the cause of the trouble (and thanks to GE's GEnial

GEntleman from Memphis: John Stoll, for that one!)

In the JA chassis circuit shown in Fig. 2, observe the novel method of supplying power to the vertical output transistors, driver and diff-amps. Note the arrows saying "To Pin-7 HVT", "Pin 6 HVT" and "Pin 9 HVT" (*H*igh *V*oltage *T*ransformer). These go to a winding on the flyback, which supplies 60V p-p pulses, of opposite polarities, to rectifier diodes Y268 and Y270. Pin 6 is the center tap on the winding. The rectified pulses are filtered by the two big capacitors and provide the dc power needed for the vertical output stage. This has one benefit: if the horizontal output stage fails, you do not have the very bright, thin horizontal line, which might burn the screen of the picture tube. When the high voltage goes out, the vertical sweep goes with it.

In the next version of this chassis, the later MA, the dc voltage for the vertical output comes from the low-voltage power supply. A +13 V supply feeds the npn transistor, and a −34 V supply feeds the pnp. A +130V supply feeds the vertical buffer transistor, through the SIZE control (and SERVICE SWITCH), and a +23V supply feeds the oscillator.

For a final "new symptom", in the JA chassis, if you see no video and no raster, and the fuse, F405, is open, check the vertical output transistors.

raster, and the fuse, F405, is open, check the vertical output transistors: both of them may be shorted.

reader questions

6BK4 PLATE GLOWING RED

The 6BK4 high-voltage regulator plate glows red, in this RCA CTC-25, at all settings of the horizontal efficiency coil. Cathode current of the 6JE6 is about 220 to 240 mA. 6BK4's have short life, too. – L.B. Marysvale, Utah.

I've seen some that would "show color" if the TV scene went dark. (Regulator taking all the current). However, I don't like to run them with red-hot plates at all times.

This naturally means that the 6BK4 is drawing too much current. "Too much" in this tube means more than *1.5 mA*. Check the 6BK4 cathode current, and adjust the control so that you do not draw more than 1.0mA, with the screen dark. At average brightness, you should draw something like 0.2 mA, or 0.2V across the 1K 6BK4 cathode resistor. This will put the dissipation of this tube in the ballpark. If it won't, check the grid resistors!

PLYMOUTH RADIO

This Plymouth 9BBCC radio will only play on strong local stations. When I opened it up, I found that someone had connected a .001-μF capacitor from the antenna trimmer to the emitter of the rf amplifier. This capacitor should go to one of the tuner coils; when I put it back there, nothing. What's going on? – J.S. Decaturville, Tenn.

Nothing is "what's going on." As far as rf gain is concerned, anyhow. You'll probably find that the rf coil is open, and that someone found out that he could shunt the signal around it, to the rf stage. This practically kills all gain in the rf stage, of course. Replace the coil, and realign.

INTERMITTENT STEREO

I'm an old tube-type technician, and I do get lost in some of the new jobs. Take this Sherwood S-7100A. While it's cold, it will play in the stereo mode, then it will switch back to mono. Plays fine, but not stereo. Need advice. – E.S. Vancouver B.C.

If you do not lose the *signal*, but only the stereo effect, this is a loss of pilot carrier. Signal-trace this through the MPX decoder circuit, frequency doubler, and so on. You'll find a "thermal" part somewhere along the way. Your scope will show this up very easily.

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I certify that the statements made by me above are correct and complete.
(Signed) H. I. Matysko, Circulation Manager

BLUE BOW

This CTV6F Motorola Quasar chassis has an odd convergence problem. Everything else seems OK, but the blue horizontal lines won't straighten out; they stay bowed upward at the ends. Checked coils and controls, which all seem to be working. Could this be somethng in the convergence yoke? J.S. Lubbock Tex.

This sounds as if you don't have enough control of your blue vertical *tilt*. This circuit makes the blue horizontal lines bow up at the ends. There is a hint on this in the manual. Note the tap on the convergence board with the blue and brown wires. Reverse these jumpers to get greater range on the blue vertical amplitude and blue vertical tilt.

Before you do anything too drastic, demagnetize the whole thing *very* thoroughly. I've seen this affect 'em.

SYNC "DROP-OUT"

They brought us a Motorola TS-597 chassis that had been dropped by movers. We replaced a couple of tubes, straightened up some more, and got pix and sound. Now all we need is some horizontal sync. The picture will barely hold, but if you move the core of the stabilizer coil even a tiny bit, out goes the sync. Very odd. – H.B., Hopewell, Va.

This has a very familiar sound! "Deductions"—If the picture will hold at all, the chances are your hold coil.

READER QUESTIONS

(continued from page 72)

afc diodes, etc. are OK. However, the reactions you're getting are those of a complete loss of the horizontal sync to the afc stage.

Under the circumstances, I'd start at the plate of the sync separator and check for correct amplitude horizontal sync at that point. Now, follow this through the PC board to the afc unit. You'll probably find a hairline crack, keeping it from getting to the diodes.

BUZZ ON "OVERLAY"

I have a problem I can't get rid of. In many of the sets I service, the owners complain of a buzz in the sound, whenever white letters or numbers are superimposed on the screen, over a picture. What can I do about this? – R.H., Cleveland Ohio.

That's right! *You* can't get rid of it. Not in the TV sets themselves, that is. It's not in them. It is something in either the network, "overlay unit" or audio of the TV transmitter. I have seen and heard this on both local *and* network programs.

A properly-operated overlay unit will *not* produce this buzz. The cause is probalby something like a slight over-modulation, which punches holes in the audio signal, making a buzz.

APPLIANCE CLINIC
(continued from page 14)

high voltage in the secondary fires the spark plug (8).

There's some very clever engineering here! Due to the special design of the flywheel magnets and core laminations, this system has an automatic spark-retard. This makes it easier to start (anyone who has ever cranked a Model T Ford with the spark *advanced* knows why!) An automatic retard of about 9° is achieved by this design. After the engine has caught, and run up to speed, anywhere from 800 rpm on up, the system automatically advances the spark by about 29°, which makes the engine run much better.

A "kill-switch" grounds the CD system, to stop the engine. This is connected through the ignition switch. This switch is used, even on hand-cranked models, for safety. It must be turned on before you can start the engine.

Troubleshooting these systems is very simple. They're purely Aristotelian: they work, or they don't! To test the system, take out the spark plug (and check it or clean it, or replace it; plugs cause most of the trouble in all small engines!). Clip the spark-plug lead to it again, and ground the shell, preferably with a dual clip lead, to the engine. Turn the ignition switch on, and crank the engine. You should get a hot, fat blue spark across the plug's electrodes. If you don't, pull the kill-switch lead, and make sure it isn't grounded. (It has a push-on connector on the ignition switch.) If you still get no spark, the CD unit could be bad.

Replacement is simple: only two screws hold it after you take off the air baffle, which has only three screws.

If the module must be replaced, you'll have to use a special non-metallic gauge to get it spaced properly with respect to the flywheel. Without this, the flywheel magnets will pull the laminations against the outside of the flywheel. Clearance at one end is .010 inch, and about ¼ inch at the other. This odd spacing is the key to proper operation of the solid-state system.

Caution: if the engine has been running, don't mess around the spark plug for at least 10 seconds! Just allow the CD pack charge to leak off. **R-E**

STEP-BY-STEP
(continued from page 62)

hard, dropping the gate voltage of starter Q602 to zero, shutting it firmly off.

With the horizontal oscillator operating, terminal 17 of the power supply board receives the IC oscillator output and routes it through C618, L605 and D609 to the base of pulse-width modulator Q606. This amplifier feeds its output back to the base of pulse-width modulator (P.W.M.) No. 2 through C614. There is another phase inversion and the resulting voltage from the collector of Q607 now passes through parallel R-C self-bias R623 and C613 to the base of current pre-driver Q605 and then on to the rest of current amplifier-chopper Q604. The 50V p-p pulse output swing at this point passes through transformer T603 R619 and L604 to the gate of GCS Q603, the large, heatsunk, regulator output. Smoothing choke L601 and filter capacitors C621, C623 do the rest.

Now, resistive dividers R603 and R604 supply a calculated 11.4 V to the top of R634 and then to the base and emitter of Q608, Q609, respectively. These are the EVP detector and error amplifiers which also receive an additional potential from 130-V ADJUST pot VR601, whose wiper is connected through R637 and R618 to the 130-V output. Small changes in the regulated supply induce small deviations in the base-collector of Q608, producing longer or shorter pulse intervals in the pulse width modulators, and therefore more or less conduction in the Q603 regulator output. A considerable change indicating a breakdown, however, will force Q609 into a conduction, firing Q610 and robbing current from the IC horizontal amplifier output, kicking the oscillator either out of sync or, removing drive altogether, killing high voltage.

The cure is not always easy

When a switched power supply is contained within itself, smart money disconnects one or more of the external loads and starts looking for a fault if there is *any* indication that the supply is operating at all. With external excitation–such as those being driven by the horizontal oscillator, as in the case of Motorola and Sony–you first measure the doubler voltage to see if there is a bad filter or if a diode is open or shorted. Next (with Motorola) remove the DA/F power supply panel. If sound returns, your probable trouble is in the power supply. If the entire power supply is changed and you still have problems, go to the output feeder lines and disconnect them one by one to find your problem.

With both Sony and Motorola, remember that the power supply will furnish *no* regulated output unless the horizontal oscillator and driver are operating. Therefore, a fault in the horizontal circuits can kill your low-voltage supply dead. In the Sony, for instance, while looking at waveforms around Q608 and Q609, the scope probe slipped suddenly, there was a sign of escaping high voltage, and the set gave up the ghost. F602 was blown, and a new one promptly got itself blown again.

Under these circumstances, an additional power supply for the 130-V and 19-V outputs might have helped considerably, but were not available. So we had to make resistance measurements by the score, several transistor checks (especially the GCS transistors), until we finally found horizontal output GCS transistor shorted. When such occurs, also check the base-emitter of horizontal driver Q509 (not shown) to make sure it hasn't gone too.

(continued on page 94)

new products

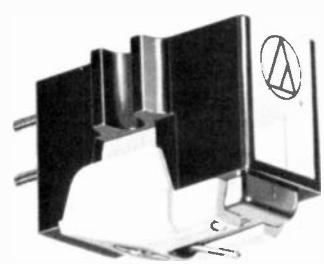
More information on new products is available from the manufacturers of items identified by a Reader Service number. Use the Reader Service Card inside the back cover.

CB TRANSCEIVER, *model 13-862* uses synthesized 23-channel circuit and advanced integrated circuitry. Transmits with full 5-watt rf input and contains selective dual-conversion receiver with tuned rf and agc. Automatic noise limiter and fully variable squelch are provided.

Large back-lighted S/RFO meter and "luma dial" channel indicator have been placed on sloped top panel that is right in sight for the diriver in normal underdash installations. Channel numbers are large; all controls, on/off/volume, variable squelch and channel selector, are clearly marked. 2 × 5-1/8 × 9"; 3 lbs.: $99.95 — complete with full-size plug-in mike, clip and mounting bracket. — **Midland Electronics Co.,** Box 19032, Kansas City, Mo. 64141.

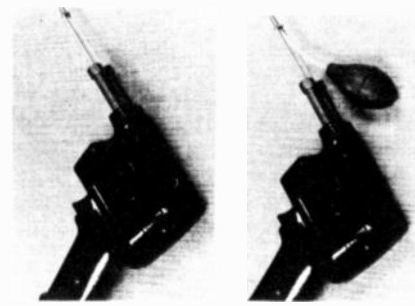
Circle 31 on reader service card

PHONO CARTRIDGE, *model AT12S* is a dual-magnet cartridge to be used with CD-4 discs. Shibata diamond tip; reduced record wear and improved tracking with stereo or matrix discs; for use in manual or automatic turntables. Frequency response: 15-45,000 Hz; channel separation (at 1 kHz): 25 dB; $49.95. — **Audio Technica U.S., Inc.,** 1655 West Market Street, Fairlawn, Ohio 44313.



Circle 32 on reader service card

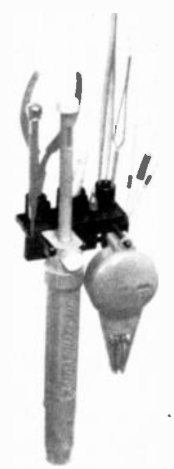
SOLDERING GUN ELEMENT, *Gunmaster* uses interchangeable soldering tips and solder removers. Element will fit most soldering guns and is permanently installed. For soldering, plastic sealing, marking, etc., a tip called the "*slug*" is screwed into the front end of the element. For removing solder by capillary action, the hollow bore desoldering tip called the "*dum dum*" is screwed into place. For removing heavy solder deposits, a solder sucker may be attached to the back end of the "*dum dum*".



Tip-holding element resists solder and will not weld itself to "*slug*" or "*dum dum*". Element heats a bit more slowly than conventional copper wire solder gun elements. — **Gunmaster Universal Industries,** P.O. Box 743, Kings Park, N.Y. 11754.

Circle 33 on reader service card

TOOL DEPOT, *part No. TD123.* Bracket is positioned at arm's length for people who like their tools nearby. Can be easily mounted in work area. Makes a convenient place to store all your soldering tools and supplies. $1.00. — **Edysn, Inc.,** 14250 Dearborn Street, Panorama City, Calif. 91402.



Circle 34 on reader service card

DIGITAL PANEL METER, *model 1230.* 3-½-digit bipolar unit uses the company's patented

dual-slope integration, 0.5" Sperry display and automatic zeroing. Standard features include: 2-nA input bias current, choice of 7.5, 15 or 30-per-second sample rate or user-con- trolled conversion and is accurate to ·0.1% of reading, ·1 digit accuracy and provides 100% overrange operation. Uses CMOS and TTL logic; 7-segment display; $135.00. — **Weston Instruments, Inc.**, 614 Frelinghuysen Avenue, Newark, N.J. 07114.

Circle 35 on reader service card

CB MICROPHONE, *model DM 301* is omnidirectional and has a 50K impedance and a frequency range of 100 to 8,000 Hz. Sensitivity is -52 dB at 1,000 Hz. Has non-locking, push-to-talk switch and is equipped with a three-

conductor, shielded curl cord that extends to 6 feet in length. Can be hand-held or operated from a fixed position; less than 6 oz. — **Shigoto Industries Ltd.**, 350 Fifth Ave., New York, N.Y. 10001.

Circle 36 on reader service card

MOTO-TOOLS, *model 370 & 380* have built-in finger-tip speed control that lets the user dial optimal rpm settings for any material. Speed range of 5,000 to 25,000 rpm provides precise control for delicate and rough sanding, drilling, cutting, etc. in a variety of material, including wood, metal, glass and plastics.

Model 370 has an 0.8-amp permanent magnet motor, oil impregnated bronze bearings, is 7-¼" long by 1-1/16" in diameter and costs $39.95. *Model 380* features ball-bearing construction, 0.9 amp permanent magnet motor, is 7-¼" long by 1-1/32" in diameter and costs $49.95. Both operate on 115V, 60 Hz ac, weigh 11 oz. and have 6'3"-long connector cord with three-pronged safety plug. — **Dremel Manufacturing Co.**, Marketing Dept., RP, P.O. Box 518, Racine, Wisc. 53401.

Circle 37 on reader service card

new literature

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 over.

SYNTHESIZER MODULES, *catalog 573.* 4-page booklet describes voltage-controlled amplifier, voltage-controlled oscillator, voltage-controlled filters, function generator, control oscillator/noise source, power supply, controller/case, keyboard/case, envelope follower/trigger, inverter/buffer, sine converter/PWM and kits.—**PAIA Electronics, Inc.,** P.O. Box 14359, Oklahoma City, Okla. 37114.

RESISTOR CATALOG, *C-509.* 8-page booklet contains 5,980 catalog items with 616 different resistance values (from 0.1 ohm to 250,000 ohms) and 15 wattage ratings (from 1 to 120 watts). Includes basic descriptions and physical sizes; complete listings of the company's wirewound resistors.—**Sprague Electric Co.,** 81 Marshall Street, North Adams, Mass. 01247.

NRI HOME TRAINING IN AIR CONDITIONING, REFRIGERATION AND HEATING. Outline of 45 lesson course covering servicing electric motors, refrigerant connections and servicing automotive heaters and air conditioners. Training units include circuit demonstrator (for learning fundamentals of electrical circuits) and control simulator (for learning electric controls). Each student receives a 5,000 BTU York window air conditioner to use as a practice unit and later for his personal use.—**NRI Training,** 3939 Wisconsin Avenue, N.W. Washington, D.C. 20016.

1973 SEMICONDUCTOR INTERCHANGEABILITY & CROSS REFERENCE GUIDE, *#451.104.* 44-page catalog lists over 6,000 semiconductor types including 1N, 2N, 3N and industry house numbers with cross references to either an exact General Electric type or a suggested replacement.—**General Electric Co.,** Semiconductor Products Dept., Electronics Park, Bldg. #7, Mail Drop 49, Syracuse, N.Y. 13201.

EQUIPMENT REPORT
(continued on page 22)

unit can be used with the 970A for reading alternating or direct current. Current ranges are from 100µA up to 1.0 A. The insertion voltage drop is only 0.2V or less.

The HP-970A is powered by a self-contained NiCad battery, which is somewhere between 9 and 11V (depends on state of charge). It slips into the end of the probe case. A special charger is included; the battery unit slips out and plugs into the charger housing. Both probe and charger are completely idiot-proof. A rib along one side of the battery case must fit into a slot in both housings before the battery will go in.

The battery will operate the 970A for about three hours; when it drops below about 9.5 volts, the display dims and it's time for a recharge. The on-off switch has a "push-to-read" position for the first click. This can extend battery life considerably. The second click is normal on position.

The LED display is bright enough to read even in pretty bright sunlight. A Display Invert slide switch can be used to turn the figures over so that the readout can be right side up no matter what position you or the instrument are in. (They have a cute little thing for this! Tiny man-figures are on the case; one is always covered by the invert switch slider. Set this so that the little man you see is not standing on his head, and there you are!)

The actual test-prod is a short one, mounted on the underside of the case. It can be folded out, with several detents so that it can be set at any angle you want. The center part telescopes, and is completely insulated. It has a very sharp tip, to make perfect contact to PC boards, etc. Two extension test prods are provided; one is a 5-inch with a sharp tip, and the other a special 2-inch, with a *hollow*, cupped tip. This one is *very* handy for hitting test-points, wire-wrap terminals, ends of wire leads on a PC board, and similar things. These extra tips fit in the socket on the end of the prod; the regular one just pulls out. Special pockets in the carrying case keep the extra rods safe.

The electronics in the 970A are a miracle of compactness. Out of the 6 inches of the case, three inches is battery, and the rest is the works. Out of this small number, most of the space is taken up by the switches. The heart of the unit is a monstrous (electronically) device roughly 0.5 by one inch. All that this contains is an analogue to digital converter, the attenuators, the auto-ranging circuitry, the auto-polarity circuitry and the logic! Outside of this, only 19 components and three switches are needed to make the whole thing!

The whole instrument is designed for "one-hand operation". This makes it potentially very useful in today's crowded instruments. The zippered carrying case even has a clip for carrying on your belt. With this, you can be the "Quick-Draw McGraw" of the electronics maintenance set!

I know too well the hazards inherent in firm statements; I have the lumps to prove it. So, I'll confine myself to saying that *as of right now*, this instruments looks to like the ultimate in "portability" when its versatility is taken into account. It should certainly be very useful to field engineers and anyone working with solid-state equipment. It would be most appreciated where the equipment to be checked is located in tight places! R-E

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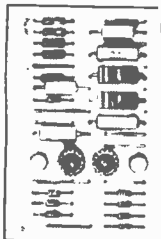

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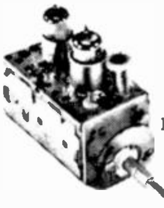

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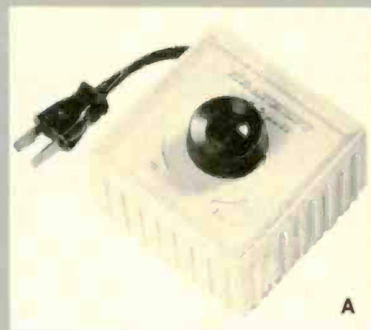

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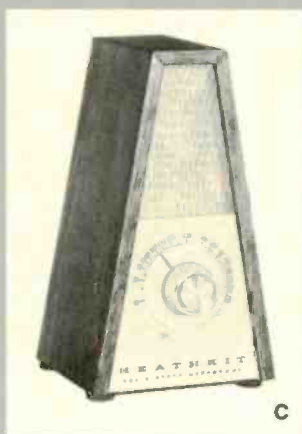

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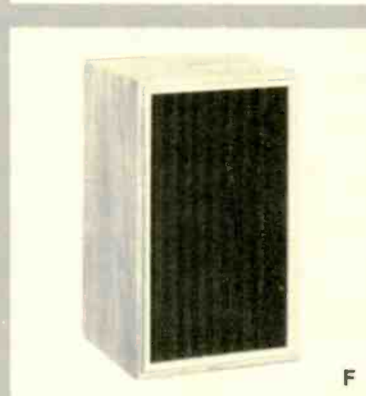

F

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A. Heathkit Lamp Dimmer — lets you adjust brightness of table or floor lamps smoothly from full on to complete invisibility. A simple, useful kit, and an interesting introduction to Triac and Diac phase-controlled switches. Handles up to 300 watts.
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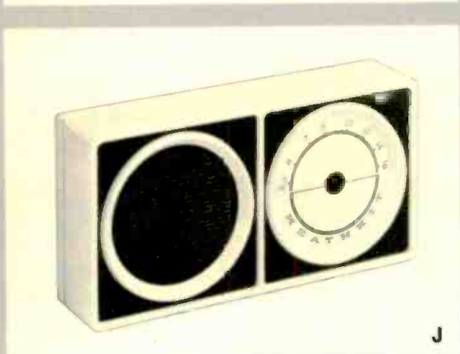

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F. Heathkit Bookshelf Speaker System — excellent reproduction with any audio system having 4 watts or more per channel. Has 4½″ high-compliance cloth-suspension speaker with sealed acoustic suspension cabinet. Measures 12″ H x 7″ W x 6″ D. Useful frequency response extends from 70 Hz to 16 kHz. Order a pair for stereo.
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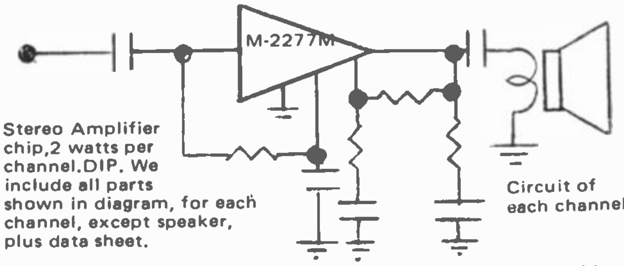

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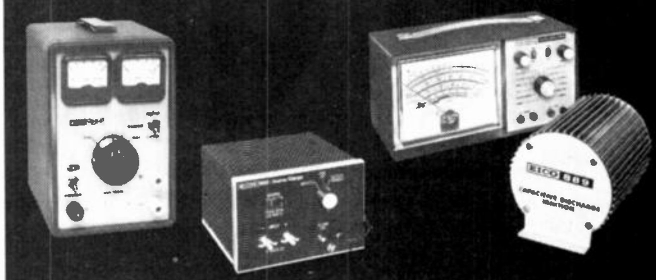

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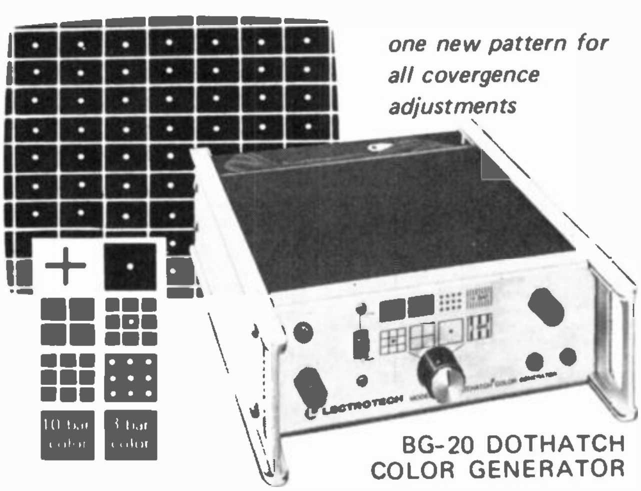

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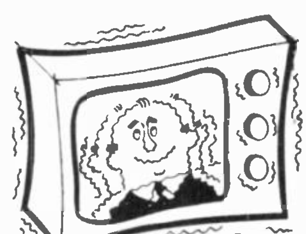

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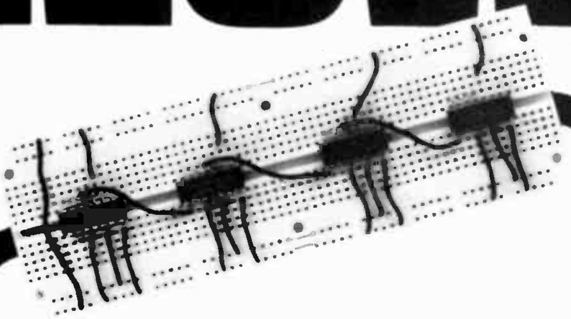

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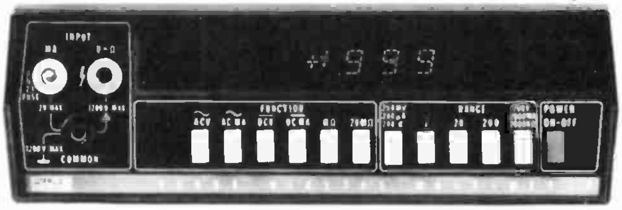

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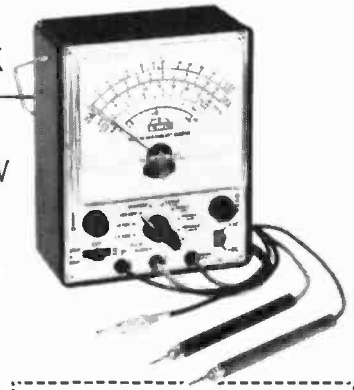

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RCA WR-525A MARKER/SIGNALYST.

Circle 89 on reader service card

THE PEOPLE AT RCA TEST EQUIPMENT have come up with another very useful unit. This is one of those little "attachment" devices, which can also work by itself. It's the WR-525A Marker/Signalyst; a solid-state rf signal generator, which covers all of the vhf TV channels, and can also be used on harmonics for uhf. It is a true Black-Box, meaning a simple, self-contained unit with useful outputs. (Actually, it's a very pretty light blue, but that's immaterial)

By plugging the WR-525A into the WR-514A TV Chanalyst, or similar sweep generator with continuous-tuning sweep on the vhf channels, you can get picture-carrier markers for each channel. By turning on the 4.5 MHz marker in the sweep generator, both sound and picture carrier markers can be used. This is a valuable test, for cases where you must know whether a set does have the correct response on all, or certain channels. For example, a set which comes from a rural or suburban area, and uses a channel not available on the air at the shop.

Two separate transistor oscillators are used, one for low channels, the other for highs. The output of these goes to an rf amplifier stage. A modulator circuit is provided. You can modulate the rf output of the WR-525A with any kind of signal desired, up to 4.5 MHz: audio, video, colorbar, crosshatch, etc. You can even use actual program material, by feeding the video detector output of a working TV set to the modulation input of the WR-525A. You'll come out with picture and sound, which can be checked on all vhf/uhf channels of the tuner under test.

This makes the instrument very handy for checking out tuners, by the signal-tracing method. The rf signal can be fed into the mixer input, then to the rf input, and finally to the antenna. This will tell you very quickly if the tuner is working, and how well. In fact, this test will give you a better idea of how a tuner is working than a sweep-alignment test. Faster, anyhow—if the tuner under test produces a clear picture or pattern on all channels; it's good!

In a few cases, when using the video signal from a color-bar generator for modulation, you'll note spurious responses 3.58 MHz above the correct frequency. This is caused by a beat in the tuner or signal generator; ignore it. Tune the dial of the WR-525A to the dot which indicates center frequency for each channel, and you'll get the right one. Incidentally, these dots are very accurate, I checked them.

Video modulating signal should be not more than 1.0 volt p-p. If it's greater than this, you may see signs of overloading. When using a color-bar generator, the attenuator will hold it down to the correct level. If you are using the video signal from another set, it may be too high. A schematic for a simple attenuator is including the instruction book.

This handy little unit has several other uses, and you'll probably find more as you go along. For example, you can feed an audio modulated marker signal into the WR-525A, and use it for setting traps, by the "dip" method. Connect the scope to the video detector output, then tune the trap for minimum audio signal; this dip shows the proper setting for the trap. An accurately calibrated marker generator is needed, of course.

The WR-525A is powered by an internal 9-volt battery, RCA VS-323 or equivalent. An external 9-volt dc supply can be used. A jack is provided on top of the case, and they even included the correct tiny phone plug to fit it. Battery life should be very good; that is, unless you leave the switch on, which isn't recommended. **R-E**

(continued from page 74)

NO COLOR

This one's got me. It's a Curtis-Mathes CMC-33, a lot like an RCA, and the complaint is simply "No color". Still, I get good color-bar patterns on the scope, at the output of the bandpass amplifier, and at the color control. Not a thing at the input of the demodulators, though. Can't figure where it's losing it. There's an odd little "box" mounted on a bracket above the control cluster. This is not shown on the schematic. Help! – R.M.G., Honobia Okla.

This is iffy, but I may know what is going on, since I fell over the same thing not long ago. Trace out your coaxial leads from the color control, and see if they don't go *through* this extra "little box". If so, this is the Atuomatic Tint Control unit they used on some models.

If you'll check, I think you'll find that one of the transistors in the ATC unit is bad. This is a "Chroma Amplifier" and must be operating, regardless of whether the ATC unit is turned on or not! (This is the same *basic* circuit found in the Magnavox T940 ATC unit, though the circuitry is different. This one had a chroma amplifier stage also)

If you can't get the service data on the ATC unit, it *is* possible to "jump" it, by running a new lead directly from the COLOR control to the demodulator input. This will disable the ATC, but let the color through.

INTERMITTENT VIDEO

This CTC-38 will play for some time, then pow! White screen, with a very faint video signal visible. Turn if off for a while, and it will come back. It's thermal, but where? – J.N., Magnet Cove, Ark.

When the video goes out, read the *emitter* voltages on each of the i.f. transistors. (I'll bet you a cuppa cawfee that it's the 3rd video i.f. transistor. I'll also bet that it's intermittently opening.) If so, you will see its emitter voltage drop to zero when it cuts out. You can speed this up by spraying it with coolant.

SNAP, CRACKLE, POP

I've replaced a bad driver transistor in this Morse 77J stereo amplifier. Now, it plays, but it has a very bad crackling sound at all times. Tried a new preamplifier transistor, which didn't help. Have you run into this? – R.J. Bogalusa La.

Yes. There are a couple more preamp transistors over on the other board, but check that little 4.7-µF electrolytic *coupling capacitor* first. We have found some of these which would cause the crackling sound, but stop when you melted the solder on the joints. Needless to say, we replaced the capacitors anyhow.

TUNER AGC VOLTAGE

According to Sams, the rf agc voltage on the tuner (Zenith 21YIC37) is supposed to be +4 V. It won't play unless I set it for –0.3V at the tuner. What should I adjust? – E.N., Elgin Ore.

Nothing. The +4V on the rf agc should be masured with NO SIGNAL input. Actual agc voltage, with signal, at this point will run from +25V to +0.3V. Check the 1.5-megohm bucking resistor from the agc line to +230V. If this goes off-value, it upsets the agc very badly.

HV PROBLEMS

There's ample grid drive in this Sylvania DO-3. In fact, it looks like a little too much. When I try to adjust the high-voltage to get the voltage down, the breaker trips. Am I over-driving it, or what? – E.W., Tuscaloosa, Ala.

There are a couple orf things which could be causing this. For one, check that .05-µF bypass in the high-voltage regulator tube cathode. If this *opens*, it will foul up the action of the regulator, and cause the breaker to trip.

Also check that little neon lamp in the high-voltage regulator circuit. If this is bad, it upsets things. Replace with an exact duplicate; this is a polarized type.

SQUIGGLES, WIGGLES, NO HV

This Zenith 14N29 chassis is driving me up the wall. While it's warming up, the waveforms around the horizontal oscillator look fine. On frequency, correct amplitude, etc. As soon as the output tube warms up, the whole thing goes all to pieces; wild oscillations, etc., and no high voltage. DC voltages close to ormal on 17JN6 horizontal output tube, quite a bit off on oscillator. Halp! – R.B., Orinda, Calif.

Cheer up; "halp" is on the way. The first one of these I ran into took me two weeks. Try this test: kill the horizontal oscillator and drive the output with signal from another set. If this works, kill the output stage and scope the horizontal oscillator. If it works, then it's certain.

You have an open filter capacitor somewhere. This is allowing a feedback loop to set up as soon as the output stage gets to full operation. So you'll find that the two stages will work separately, but not together.

TOO MUCH BRIGHTNESS

I can't get the brightness to turn down on this Airline GAI-17423B color set. Also have had vertical retrace lines. Checked all transistors, cathode voltages on picture tube, and so on. The brightness control will vary the grid voltage on the 11CH11 tube. I'm stuck. – J.T.'s Radio-TV, Elk City, Okla.

From the long list of voltages you gave, I'm beginning to suspect one fairly simple thing. Everything looks normal. Check the setting of the three picture tube *screen* controls; I think you'll find them cranked wide open. Check the BRIGHTNESS RANGE control setting while you're there. (I got booby-trapped on one like this, and not too darn long ago, either.) Some previous tinkerer must have turned them up.

MORE ON "MANY, MANY SYMPTOMS"

Referring to your answer on the "Many, many symptoms" question, in the Aug. 1973 issue, on a CTC-38, I have found this kind of trouble in this chassis. It was due to a leaky capacitor between the 1st video amplifier and the video-sync-chroma amplifier. This is a .047-µF V; C41 in the Sams Photofact 1000-3. Replace it with a 100V unit for safety. – Dan Scott, Scotty's TV Service, Madison, Wisc. **R-E**

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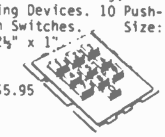

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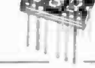
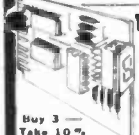


LED MITY DIGIT "DCM'S"



*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

100-PC. JUMBO CORNING "METAL OXIDE" RESISTOR KITS

☐ Only $2.50

KRONOS WITH "TIME BASE"*

Cabinet is 6" x 5½" x 6"

CHOOSE YOUR READOUT

$47. Any Type Clock less time-base — NEW FOR 1974!

* With TIME BASE $64.95

Type	LED	Charac.	Sale
☐ KR-101	MAN-3	.12	$47.
☐ KR-102	MAN-1	.27	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!
- Compare and see!
- 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 have the GREEN LED readouts at a slightly extra cost. We 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 with 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.

SPECTROL CERMET "MICRO" POTS

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

Your Choice **Any 2 for $1**

☐ 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, ¼ 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 KEYBOARD SWITCH KITS

Kit of 17 for $7.50

Each switch made by Oak #415, SPST normally open, 24V 1 amp contacts. Kit includes 0-to-9 (10 switches white with black numerals) decimal, white with black dot, and CE, CL and 4 functions blue with white characters.

☐ 10-pc. kit, 0-to-9 only, same type as above. **3.50**

12-DIGIT "CALCULATOR CHIP"

CT5001 Chip ☐ **$6.95** 3 for $18.

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. We include schematics, instructions to build calculator.

- ☐ CT5002-9 Volt version of above — $8.88
- ☐ CT5005-Same as above with MEMORY — $14.95

NATIONAL EQUALS ON "DIGITAL CLOCK on a CHIP"

Any "Chip" ☐ as Low as **$9.95**

*Money Back Guarantee!

Mfrs #	Description	Sale
☐ 5311	28-pin, ceramic, any readout, 6-digits: A-B-D	$12.88
☐ 5312	24-pin, ceramic, any readout, 4-digits: C-D	$ 9.95
☐ 5313	28-pin, ceramic, any readout, 6-digits: A-C	$ 9.95
☐ 5314	24-pin, plastic, LED and incandescent readouts, 6-digits: A-B	$12.88

Code: A—Hold Count. C—1 PPS Output. B—Output Strobe. D—BCD

*With Spec Sheet

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

NATIONAL MM5316 EQUAL 'ALARM CLOCK ON A CHIP'

MOS 40-pin dip IC. Four display modes time, seconds, alarm and sleep, for a variety of digital clocks. Interfaces directly with 7-segment flourescent and liquid crystal displays. Requires single power supply. 12 or 24 alarm setting, featuring 9-minute SNOOZE ALARM and pre-settable 59-minute sleep timer. Low power dissipation only 32mw @ 8V. Operates from 8 to 29 volts. NO REGULATION REQUIRED! Only needs 4-digits. Has seconds provisions, with instant press of button. Has many, many features. The only ALARM CHIP on the market today at this low Poly Pak price. With 5 pages of tech. info, plus applications.

☐ Only **14.95**

NIXIE COUNTING SYSTEM

☐ **$5.95** 3 for $16.00

Includes SN7490, decade counter, SN7475 latch, SN7448 BCD decoder driver, 0-to-9 Nixie With socket.

$1.49 HIGH POWER TRANSISTOR WITH HEAT SINK

Removed from new equipment! Includes popular 2N174 'doorknob' transistor TO-36, germanium, PNP, 150, watts, VCBO 80V, 15 amps, 40 hfe. For ignition, high power transmitters, etc. Mounted on heat sink 5 x 2½ x 1¼".

☐ **$1.49** 3 for $3

1-WATT FLANGELESS TOP HAT ZENERS

5 for $1

Type TK, Metal Case

Volts	Volts	
☐ 4.7	☐ 9.1	☐ 13.
☐ 6.3	☐ 10.	☐ 15.
☐ 8.2	☐ 12.	☐ 30.
		☐ 33.

Potter & Brumfield KAP RELAYS

Your choice 3 for $7.50 **$2.98**

Excellent for "HAM" use as antenna switching, latching, transmit, receive, etc., and 100's of commercial or industrial uses. Includes plastic dust-cover with diagram and hookup info, 11-pin plug-in base. Contacts movable gold flashed silver, stationary overlay, with silver cadmium oxide movables. All contacts 10 amp 3PDT. Coil data,115VAC 2250 ohms, 17.5 ma, 12 VDC 21 mils 168 ohms. Size: 2¼" x 1 5/16". Wt. 4 ozs. Center pin missing. Comar Mfg. type equal too.

3PDT ☐ 12 VDC ☐ 115 VAC

MUX'D DIGITAL CLOCK PC BOARD

Your choice **$2.50**

- ☐ 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.

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

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.

STUD 'TRIACS'

PRV	15 amp	25 amp
50	☐ $.65	☐ $.85
100	☐ .85	☐ 1.05
200	☐ 1.25	☐ 1.45
300	☐ 1.45	☐ 1.65
400	☐ 1.85	☐ 1.95
500	☐ 2.55	☐ 2.25
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Circle 85 on reader service card

STEP-BY-STEP TROUBLESHOOTING

(continued on page 77)

Throughout the entire proceeding, your author (for once) wasn't able to use an oscilloscope—simply a 20-kilohm/voltmeter. Obviously in the low ranges, this instrument has a lower impedance than any fet meter or vtvm and will supply enough current and voltage to forward-bias both transistors and diodes. If you wish to 'scope this supply, we'd suggest you solder a number of small wires to the various terminals of interest, so that another probe slip won't cost you time, frustration and money.

A prime suggestion in working with any of these gate controlled switches is a little diagram Sony has been careful to include (Fig. 5), and we'll pass on to you. As you can see, ohmmeter measurements are between gate *and* K (cathode) and A (anode) in the polarities indicated and at the approximate resistances given. Similar measurements forward and backward decidedly means you have a bad (probably shorted) gcs. If in doubt, compare its measurements (out of circuit) with another new one.

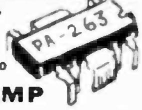
These switches, it seems, can prove somewhat tender. In checking RCA SCR switching (also Heath and Philco) high-voltage circuits, use a variable line voltage transformer (Variac, etc.) and proceed slowly after 85 volts. You'll save lots of SCR's.

The rest of your troubles can at least be approached by the troubleshooting chart printed here. It is impossible, of course, to cover all the possibilities in switched and non-switched power supplies. But the directions given can go a long way toward relieving your troubles. **R-E**

BRAND NEW LOWEST PRICES

GENERAL ELECTRIC **$2.50** 3 FOR $6.00

3-WATT AUDIO AMP



Delivers 3 watts continuous, 10 watts peak. With heat sinks; micro-mini size: 3/4x1/2x1/2". 9 to 30V supply. High sensitivity. 8 to 16 ohms. For mono and stereo phonos, tape, FM, AM, TV, servo.

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Buy 3 or more, 10% discount

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Type	Sale	Type	Sale	Type	Sale	Type	Sale	Type	Sale
SN7400	$0.30	SN7437	.55	SN7472	.50	SN74112	.95	SN74163	1.95
SN7401	.30	SN7438	.55	SN7473	.55	SN74113	.95	SN74164	2.95
SN7402	.30	SN7440	.30	SN7474	.55	SN74114	.95	SN74165	2.10
SN7403	.30	SN7441	1.40	SN7475	1.00	SN74121	.60	SN74166	2.05
SN7404	.35	SN7442	1.50	SN7476	.65	SN74122	.95	SN74173	2.50
SN7405	.35	SN7443	1.50	SN7478	.95	SN74123	1.20	SN74174	3.20
SN7406	.45	SN7444	1.50	SN7480	.65	SN74125	.71	SN74175	3.20
SN7407	.55	SN7445	1.50	SN7481	1.25	SN74126	.71	SN74176	2.10
SN7408	.35	SN7446	1.65	SN7482	.99	SN74139	1.25	SN74177	2.10
SN7410	.30	SN7447	1.45	SN7483	1.25	SN74140	1.25	SN74179	2.10
SN7411	.35	SN7448	1.50	SN7485	1.41	SN74145	1.55	SN74180	1.20
SN7413	.95	SN7450	.30	SN7486	.55	SN74148	4.50	SN74181	4.90
SN7415	.55	SN7451	.30	SN7489	4.50	SN74150	1.61	SN74182	1.20
SN7416	.55	SN7453	.30	SN7490	1.49	SN74151	1.25	SN74185	2.50
SN7417	.55	SN7454	.30	SN7491	1.35	SN74152	4.95	SN74192	1.95
SN7420	.30	SN7455	.55	SN7492	1.35	SN74153	1.60	SN74193	1.95
SN7421	.55	SN7460	.30	SN7493	1.35	SN74154	2.10	SN74194	1.95
SN7422	.35	SN7461	.35	SN7494	1.35	SN74155	1.55	SN74195	1.25
SN7425	.50	SN7462	.35	SN7495	1.35	SN74156	1.45	SN74196	2.50
SN7426	.36	SN7464	.30	SN7496	1.35	SN74157	1.55	SN74197	2.50
SN7430	.30	SN7465	.50	SN74106	.95	SN74158	1.55	SN74198	2.65
SN7432	.35	SN7470	.50	SN74107	.70	SN74160	1.95		
		SN7471	.55	SN74108	.95	SN74161	1.95		

WORLD FAMOUS SEMI-KON **Dollar Stretchers**

- 20-HEAT SINKS for all types of TO5 trans. makes 'em high power $1.
- 2 – 2N5296 35-WATT NPN PLASTIC TRANSISTORS, for NE-540 $1.
- 2 – 2N6109 40-WATT PNP PLASTIC TRANSISTORS, for NE540 $1.
- 10-1N82 GERMANIUM UHF diode, clip-in type* $1.
- 5-SCRs 7-AMP TO220, 6-12-24 prv, power tab $1.
- 10-MOS FETS, 3N187, 3N200, 3N128, TO-18, Fairchild* $1.
- 5-SCRS & TRIACS up to 25 amps, 6-12-24 prv, studs too $1.
- 2 – 2N3819, Texas, N channel, 6500 umho TO-18 $1.
- 2 – 2N2646 UNIJUNCTIONS, plastic transistors, Texas $1.
- 5 – 2N107, GE, most commonly used pnp, germanium $1.
- 50 – SILICON, glass rectifiers, computer, axial leads $1.
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- 5 – 2N170, GE, RF, germanium, npn, transistors, TO-22 $1.
- 6 – 1-AMP 1000 PIV, epoxy, subminl, silicon rectifiers $1.
- 30 – 500MW ZENERS, axial 4, 6, 9, 10, 12V rectifiers $1.
- 4 – 2N3055, HOBBY, 40W npn silicon transistors, TO-3 $1.
- 30 – 3-AMP RECTIFIERS, silicon, epoxy, assorted V. axial* $1.

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- 2 – PHOTO TRANSISTORS, with darlington amp, 2N5777, GE $1
- 4 – PHOTO CELLS, Clairex, pancake, 30K-70 ohms $1

- 1 – 2N3055 npn, 100W, 15A, TO-3, transistor $1.
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- 2 – FET'S 2N5457 N channel 5000 umhos, TO-92 plastic $1.
- 10 – 1N914 fast switch diodes, silicon, 4 nanoseconds $1.
- 2 – 6 AMP TRIAC 200 PRV, TO-5 $1.
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- 2 – 6000 PIV 50 mil epoxy rectifiers, axial leads* $1
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- 1 – 2N5036 HI-PWR plastic trans 100 vceo, 7 amp 85 watts $1.
- 4 – 2N5296 HOBBY, 35 watts, plastic powers, NPN $1.
- 4 – 2N6109 HOBBY, 40 watts, plastic powers, PNP $1.
- 5 – PLASTIC 35W powers, npn, silicon, hobby 2N6121 $1.
- 5 – PLASTIC 35W powers, pnp, silicon, hobby 2N6124 $1.
- 2 – MOS FETS, N channel 10K umos 3N128, TO-18, RCA $1.
- 2 – MOS FETS, DUAL GATE, N chan. 3N187, TO-18, RCA $1.
- 2 – MOS FETS, DUAL GATE, N chan. 3N140, TO-18, RCA $1.
- 4 – RCA 2N3600 NPN, UHF transistors, tv-fm, TO-18, 1000mc $1.
- 1 – 300V PLASTIC POWER TAB transistors, 6A $1.

I.C. & LED HOBBY-ONICS

Factory fallouts, good-bad-no good, money-back guarantee!

- 3-1-WATT AUDIO AMPLIFIERS, Westinghouse, TO-5 $1.
- 15-709 FLAT PAK OP AMPS, 100% good $1.
- 50-710-711 flip flop COMPARATORS, untested $1.
- 4-DUAL 709, dip pak, op amps, untested $1.
- 5-7474D triggered flip-flops, dip, no test $1.
- 2-1101 256 BIT ram special, dip, no test $1.
- 5-SN7447 7-Seg. decoder-driver fallouts $1.
- 10- TO-5 Case 536, 540, 565, 567, 741* $1.
- 5-MOS REGISTERS, 5013-17, mini dips, no-test $1.
- 5-MOS REGISTERS, 501-6, etc., TO-5, no-test $1.
- 5 – SN7441N, hobby, BCD-to-Nixie driver IC, DIP* $1.
- 10 – LINEAR AMPS, 709, 710, 711, 741, TO-5 $1.
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- 5 – HOBBY MEMORY CELLS, SN7481, up to 16-cell, DIP* $1.
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- 2 – VOLTAGE REGULATORS, LM309K, hobby, TO-3* $1.
- 10 – SIGNETIC OP AMP, 531, 533, 536, 550, 555, DIPs, TO-5* $1.
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- 1 – CALCULATOR ON A CHIP, hobby, exp. 40-pin, specs* $1.
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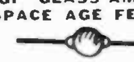
- 7-SN74121 DIP, multivibrator, fallout, u test 'em $1.
- 5-LM-300 Super 723, manufacturers' fallouts, u test 'em $1.
- 5-IBM IC's with pc board, many parts, from computors $1.
- 1-AM RADIO-ON-A-CHIP, by Sprague, DIP, u test 'em $1.
- 1-DUAL 2-WATT "Stereo-Amp-On-A-Chip", fallout Sprague, u test $1.

*Untested, guaranteed satisfaction

- 1-OPCOA SLA-11C, like MAN-5, green, seg missing $1.
- 4-SPERRY SP332, twin digit, factory rejects, .33" charac, no test $1.
- 1-OPCOA SLA-11*, like MAN-5, green, 1-or-more segs gone $1.
- 1-OPCOA SLA-3H*, 0.7 charac. readout, 1-or-more segs missing $1.
- 5-MONSANTO opto isolators, no test, 1500V $1.
- 10-LED HOBBY SURPRIZE, asst. types, factory rejects, no test $1.
- 2-OPCOA SLA-1*, MAN-1, red, .33" charac. 1-or-more segs gone $1.
- 2-MONSANTO MAN-4, .19" charac. 1-or-more segs missing, red $1.
- 5-MONSANTO MAN-3, .12" charac. red 1 or more segs missing $1.

*Reflective bar segments, while Monsanto all LED segments.

GI "GLASS AMP II" SPACE AGE FEATURES



Type	PIV	Sale
1N4245	200	$.14
1N4246	400	.22
1N4247	600	.39
1N4248	800	.49
1N4249	1000	.59

Meets critical JAN specs. A glass "ball of silicon strength" that meets JAN specs, high reliability, withstands avalance power surges to 1K watts. ONE amp ratings with 2 amp capabilities. Axial leads.

EPOXY FULL WAVE SILICON BRIDGE RECTIFIERS

PIV	2 Amp	6 Amp
50	$.69	$.88
100	.79	.99
200	.95	1.25
400	1.19	1.50
600	1.35	1.75
800	1.59	1.95
1000	1.79	2.25

Code: 2 amp TO-5 case. 6 Amp 1/2 x 1/2 x 3/16 sq

LOWEST PRICES

EPOXY SILICON RECTIFIERS *microminiature

PIV	2Amp*	2Amp	3Amp
50	$.05	$.05	$.08
100	.06	.06	.12
200	.07	.07	.15
400	.09	.09	.22
600	.12	.12	.28
800	.15	.15	.39
1000	.18	.18	.45

"C-MOS" IC CIRCUITS

Type	Sale
74C00	$.95
74C02	.75
74C04	1.15
74C10	.95
74C73	1.79
74C74	1.59
74C76	1.79
74C157	2.50
74C160	3.50
74C161	3.50
74C162	3.50
74C163	3.50
74C195	4.50

RCA TYPE "C-MOS" IC's

Type	Sale
CD4001AE	$ .71
CD4002AE	.71
CD4009AE	1.69
CD4011AE	.71
CD4012AE	.71
CD4013AE	1.62
CD4016AE	1.62
CD4023AE	.71
CD4035AE	4.16

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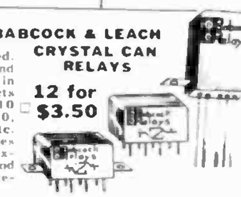
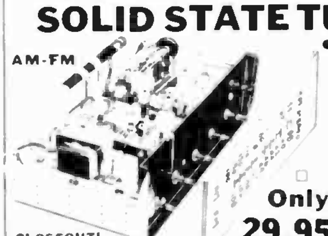
12 for $3.50

All hermetically sealed. Subminl, 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.



20-WATT STEREO AM-FM MULTIPLEX SOLID STATE TUNER & AMPLIFIER!

• FM freq: 88 to 108 mc! AM: 550 to 1600 kcs!

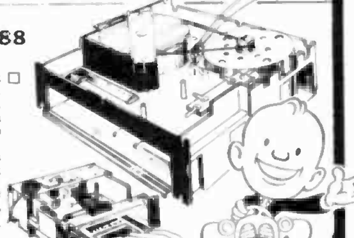


Only 29.95

Lucky purchase enables us to give you this console type unit at portable prices. Consists of solid state products throughout. Made by Symphonic Mfg. AM section 550 to 1600 kcs, FM section 88 to 108 mcs. Escutcheon, glass with all proper markings. Complete with AFC. Slide rule tuning. Built-in AM antenna. Built-in all SOLID STATE 20 watt stereo amplifier. With MULTIPLEX! Has tape input and outputs, phono input. Light indicators for dial and stereo. Compact chassis only 13 x 6 x 4". Modular technique used in design. 6 controls: VOLUME, TREBLE, BASS, TUNING, BALANCE, and multi-position switch control for AM-FM-AFC, AUXILIARY, PHONO, TAPE. Wt. 4 lbs. With hookup diagrams. With knobs.

8-TRACK CAR RADIO STEREO TAPE TRANSPORT **$8.88**

Contains complete 8-track stereo recording/playback unit you find in expensive car tape decks. Excellent direct replacement unit if your own does not function properly. Priced to toss away old, and replace with new. Less amplifier. Design your own hi-fi stereo systems around it. Uses standard 8-track cartridge. With hi-fi stereo tape and all its mechanical parts that go with it. Operates off 12VDC. Automatic track locating and changing plus track indicator output. 3 3/4 ips speed. WOW and FLUTTER less than 0.5% MU metal shield motor reduces motor noise to an inaudible one. Uses separate 739 preamp and is ready to go. Size: 5 x 5 x 2".



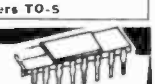
NATIONAL 'OP' AMPS

BUY ANY 3 — TAKE 10%

Type	Description	Sale
LM-300	Super 723 V. reg.	$1.49
LM-301	Hi-performance amp	.49
LM-302	Voltage follower	1.49
LM-304	Neg. V. reg.	1.49
LM-305	Pos. V. reg.	1.49
LM-307	Super 741	.59
LM-308	Hi-Q Fet Type Op Amp	1.50
LM-309H	5V 200 mil V. reg.	1.50
LM-309K	5V 1-amp V. reg.*	2.25
LM-311	Comparator	1.50
LM-320	Minus 5V 1-amp V.R.*	1.95
LM-320	Minus 12V 1-amp V.R.*	1.95
LM-320	Minus 15V 1-amp V.R.*	1.95
LM-350	Dual peripheral driver	.59
LM-370	AGC squelch op amp	1.49
LM-371	R-F, I-F, op amp	.69
LM-373	AM-FM, SSB, I.A.D.	3.75
LM-374	AM-FM, SSB, IVAD	3.75
LM-380	2-watt audio amplifier	1.95
LM-3028	Differential RF/IF amp	1.50
LM-3070	Chrome regenerator	1.50
LM-3071	TV chroma IF amp	1.50

*TO-3 case, — others TO-5

"MEMORY LANE"



Type	Description	Sale
1101	256 Bit RAM MOS	$3.50
1103	1024 Bit RAM MOS	8.50
2516	Character Gen. ROM	12.50
7489	64 Bit RAM TTL	3.50
8223	Programmable ROM	7.95
MM5260	1024 Bit RAM	7.95
MM5262	2048 Bit RAM	12.50

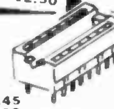
LINEAR Op Amps • FACTORY GUARANTEED • FACTORY TESTED • FACTORY MARKED

Buy Any 3 PAKS — Take 10% Discount

Type	Description	Sale
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)	3.95
537	Precision 741 (TO-5)	2.50
550	Precision 723 voltage reg. (DIP)	1.17
556	5 Times faster than 741C	2.10
558	Dual 741 (TO-5)	1.00
560	Phase lock loops (DIP)	3.25
561	Phase lock loops (DIP)	3.25
562	Phase lock loops (DIP)	3.25
565	Phase lock loops (A)	3.25
566	Function generator (TO-5)	3.25
567	Tone decoder (A)	3.25
702C	Hi-grain, DC amp (TO-5)	.49
703C	RF-IF, amp, 14 ckts (TO-5)	1.00
704	TV sound IF system	1.50
709C	Operational amp (A)	.49
709CV	Op amp (mini DIP)	.49
710C	Differential amp (A)	.49
711C	Dual diff. comp (A)	.49
723C	Voltage regulator (A)	.95
733	Diff. Video Amp	1.75
741C	Frequency compensator 709 (A)	.49
741CV	Freq. comp 709 (Mini DIP)	.49
747C	Dual 741C (A)	1.25
748C	Freq. adj. 741C (A)	.49
753	Gain Block	1.75
709-709	Dual 709C (DIP)	1.00
739-739	Dual stereo preamp	1.98
741-741	Dual 741C (A)	1.00
PA265	5-Watt voltage regulator	1.95
ULN2300M	Op amp with SCR	1.50
CA3065	Video Audio system	1.50

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

INTEGRATED CIRCUIT SOCKETS



- 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

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POLY PAKS

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Circle 85 on reader service card

INTERNATIONAL ELECTRONICS UNLIMITED

NEW YEAR SPECIALS

1101	256 Bit RAM MOS 2501	$2.00 ea.
8223	Programmable ROM	5.95 ea.
LM309K	5V 1A Regulator	1.75 ea.
9601	Retriggerable One Shot	.85 ea.
LM75451	Dual Peripheral Driver	.39 ea.
7437	Quad 2-in NAND Buffer	3/$1.00
7438	Quad 2-In NAND Buffer	3/$1.00
7453	Expandable AND-OR-INVERT gate	4/$1.00
7490	Decade counter	1.10 ea.
74121	One Shot (monostable multivibrator)	.39 ea.
74193	Up/down binary counter	1.39 ea.

5002 LSI Calculator Chip

Battery powered version of 5001
with 12 MAN 3M LED
Complete with Data $19.95/set

MM5312 Digital Clock Chip

28 pin · any readout · 6 digit BCD
with 4 MAN 3M LED
Complete with Data $11.95/set

MOS Grab Bag

8 Untested MOS MIX (dip) . . . . $ 2.00
50 Untested MOS MIX (dip) $10.00

5001 LSI Calculator Chip

Overstocked on this popular calculator chip.
This month only . . . With Data . . . . $ 4.95 ea.

NEW YEAR SPECIALS IN EFFECT THROUGH JANUARY

TTL

7400	$ .25	7446	$1.45	74122	$ .55
7401	.25	7447	1.45	74123	1.15
7402	.25	7448	1.50	74126	.95
7403	.25	7450	.29	74145	1.25
7404	.29	7451	.32	74150	1.25
7405	.27	7453	.32	74151	1.05
7506	.55	7454	.45	74153	1.45
7407	.53	7455	.32	74154	1.75
7408	.29	7460	.30	74155	1.35
7409	.29	7461	.30	74156	1.50
7410	.25	7464	.45	74157	1.50
7411	.35	7465	.45	74161	1.65
7413	.95	7470	.50	74163	1.80
7415	.50	7472	.45	74164	2.95
7416	.50	7473	.55	74165	2.95
7417	.50	7474	.55	74166	1.95
7420	.25	7475	.95	74173	1.95
7421	.32	7476	.55	74175	1.95
7422	.32	7478	.89	74176	.95
7423	.37	7483	1.25	74177	.95
7425	.39	7485	1.20	74180	1.15
7426	.35	7486	.55	74181	4.25
7427	.39	7489	3.25	74182	1.10
7430	.25	7490	1.25	74190	1.65
7432	.30	7491	1.40	74192	1.65
7437	.50	7492	1.05	74193	1.65
7438	.55	7493	1.05	74194	1.65
7440	.25	7494	1.10	74195	1.15
7441	1.25	7495	1.05	74196	1.35
7442	1.15	7496	1.05	74197	1.15
7443	1.25	74100	1.40	74198	2.50
7444	1.30	74107	.55	74199	2.50
7445	1.25	74121	.65		

Low Power TTL

74L00	$ .40	74L42	$1.75	74L85	$1.25
74L02	.40	74L45	1.45	74L86	.95
74L03	.40	74L51	.40	74L90	1.75
74L04	.40	74L71	.60	74L91	1.50
74L06	.40	74L72	.60	74L93	1.75
74L10	.40	74L73	.80	74L95	1.75
74L20	.40	74L74	.80	74L164	2.95
74L30	.40	74L78	.80		

8000 Series TTL

8054	$ .45	8123	$1.75	8570	$2.95
8060	.30	8182	1.75	8600	1.15
8091	.69	8214	1.95	8810	.95
8092	.69	8230	2.95	8812	1.25
8093	.69	8280	.95	8822	2.95
8094	.69	8288	1.05	8830	.69
8122	1.05	8520	1.45	8831	2.95

ALL DIP PKGS.
Specify spec. sheets required with order. Add $ .50 per spec sheet for items less than $1.00 ea.

Linear

LM 300	Pos V Reg (super 723)	TO5		$ .95 ea.
LM 301	Hi performance AMPL	TO5		.45 ea.
LM 302	Voltage Follower	TO5		.95 ea.
LM 304	Negative Voltage Regulator	TO5		1.25 ea.
LM 305	Positive Voltage Regulator	TO5		1.25 ea.
LM 307	Op AMP (super 741)	TO5		.45 ea.
LM 308	Micro Power Op Amp	TO5		1.25 ea.
LM 309H	5 V Regulator	TO5		1.25 ea.
LM309K	5 V 1A Regulator	TO3		1.95 ea.
LM 310	Voltage Follower Op Amp	TO5		1.45 ea.
LM 311	Hi Perf. Voltage Comp.	TO5		1.25 ea.
LM 320	-5.2 V Negative Regulator	TO3		1.95 ea.
LM 320	-12 V Negative Regulator	TO3		1.95 ea.
LM 320	-15 V Negative Regulator	TO3		1.95 ea.
LM 370	AGC/Squelch Amp	DIP		1.29 ea.
LM 372	AF - IF Strip-detector	DIP		.85 ea.
LM 376	Pos Voltage Regulator	DIP		.65 ea.
LM 380	2 watt Audio Amplifier	DIP		1.75 ea.
LM 550	Precision Voltage Regulator	DIP		.95 ea.
LM 709	Op Amp	TO5 or DIP	10/$3.25	.39 ea.
LM 723	Voltage Regulator	TO5 or DIP	5/$3.25	.75 ea.
LM 741	Comp. Op Amp	TO5 or DIP	10/$3.95	.45 ea.
LM 747	Dual 741 Op Amp	TO5 or DIP	4/$3.50	.95 ea.
LM 3900	Quad Amplifier	DIP		.50 ea.
LM 75451	Dual Peripheral Driver	DIP		.49 ea.
LM 75452	Dual Peripheral Driver	DIP		.49 ea.

Specify TO5 or Dip Package
Specify spec sheets required with order. Add $ .50 per spec sheet for items less than $1.00 ea.

Phase Locked Loops

NE 565	Phase locked loop	TO5 or DIP	$2.95 ea.
NE 566	Function Generator	TO5 or DIP	2.95 ea.
NE 567	PLL/TONE Gen.	TO5 or DIP	2.95 ea.

Memories

1101	256 bit RAM MOS (2501)	$2.50 ea.
1103	1024 bit RAM MOS	7.95 ea.
7489	64 bit RAM TTL	3.25 ea.
8223	Programmable ROM	6.95 ea.

*** NEW ITEM ***

MM 5260 — 1024 bit RAM Second generation version of 1103 . . . Featuring 16 pin DIP rather than 18 pin . . . 30% less power consumption . . .
Introductory Price . . . 9.95 ea.

CMOS

74C00	$ .90	74C73	$1.70	74C161	$3.25
74C02	.90	74C74	1.50	74C162	3.25
74C04	1.10	74C76	1.70	74C163	3.25
74C10	.90	74C107	1.50	74C192	3.25
74C20	.90	74C157	2.25	74C195	3.00
74C42	2.15	74C160	3.30	80C97	1.50

Calculator Chips

5001 LSI (40 pin) Add, subtract, multiply & divide 12 digit
Data supplied with chip . . . . $6.95 ea.
Data only-Refundable w/purchase . . . . . 1.00 ea.

5002 LSI Similar to 5001 except designed for battery power
Data supplied with chip . . . . $8.95 ea.
Data only-Refundable w/purchase . . . . . 1.00 ea.

5005 LSI (28 pin) Full four function memory. 12 digit display and calc. 7 segment multiplexed output
Data supplied with chip $10.95
Data only-Refundable w/purchase . . . . . 1.00 ea.

LED

MV10B Visible red SUPER SPECIAL	$ .25 ea.
MV50 type red emitting	.25 ea. 5/$1.00
MV5020 type Large red	.35 ea. 3/$1.00
ME4 Infra red TO18	.69 ea.
MAN 1 The original	3.95 ea.
MAN 3 type	1.95 ea. 3 or more 1.49 ea.
MAN 4 type	2.75 ea. 3 or more 2.50 ea.
Data-Lite 707 (MAN 1 repl)	3.25 ea.

Opto Isolators

MCA 2-30	Darlington	$ .95 ea.
MCD 2	Diodes	1.95 ea.
MCT 2	Transistor	1.45 ea.

4000 Series — RCA Equivalent

CD 4001	$ .65	CD 4011	$ .65	CD 4025	$ .65
CD 4002	.65	CD 4012	.65	CD 4030	.65
CD 4009	1.50	CD 4016	1.50	CD 4035	3.65
CD 4010	.65	CD 4023	.65		

Digital clock . . . on a Chip

MM 5311 (28 pin) Any readout 6 digit BCD with spec. sheet — $11.95 ea.
MM 5312 (24 pin) Any readout 4 digit 1pps BCD with spec. sheet — 8.95 ea.
MM 5313 (28 pin) Any readout 6 digit 1pps BCD with spec. sheet — 10.95 ea.
MM 5314 (24 pin) LED-incandescent readout 6 digit with spec sheet — 10.95 ea.
MM 5316 (40 pin) Normal alarm, snooze alarm, sleep timer 12 or 24 hr. operation with spec. sheet — 15.95 ea.

UNTESTED SECONDS

MM502	Dual 25-bit dynamic shift register	TO5	$ .35 ea.
MM503	Dual 50-bit dynamic shift register	TO5	.35 ea.
MM504	Dual 16-bit static shift register	TO5	.35 ea.
MM505	Dual 32-bit static shift register	TO5	.55 ea.
MM5006	Dual 100-bit shift register	TO5	.35 ea.
MM5010	Dual 64-bit accumulator	TO5	.25 ea.
MM5016	512 bit dynamic shift register	TO5-DIP	.25 ea.
MM5013	1024 bit dynamic shift register/accum.	TO5-DIP	.55 ea.
MM5019	Dual 256 bit mask prog. shift register	TO5	.25 ea.
MM5050	Dual 32-bit static shift register	TO5	.35 ea.
MM5053	Dual 100-bit static shift register	TO5	.25 ea.
MM5054	Dual 64/72/80 bit static shift register	DIP	.35 ea.
MM5230	2048-bit read only memory	DIP	1.00 ea.
MM5240	2560-bit static character generator	DIP	1.00 ea.
MM1403	1024-bit dynamic shift register	DIP	.65 ea.
MM1404	1024-bit dynamic shift register	DIP	.65 ea.

MOS Shift Registers 2500 Series
2502 2506 2509 2510 2511 2518 2519 2521 2522
Untested seconds 4/1.00

Grab Bag Specials
15 Assorted TTL's (dips) $1.00/bag
25 Assorted DTL's (dips) $1.00/bag

ON ORDERS OVER $25.00 DEDUCT 10%

Satisfaction guaranteed. All items except as noted are fully tested. Minimum order $5.00 prepaid in U.S. and Canada. Calif. residents add sales tax. Orders filled within three days from receipt.

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Circle 84 on reader service card

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NICKEL CADMIUM BATTERIES

- ☐ 0.5 ampere hour 1.25 volt sealed button cell . . . . 2 for $1.00
- ☐ Vented 4.0 ampere hour cell, plastic case $2.75
- ☐ 24 volt pack, sealed cells, mfg sonotone, size 12" x 1¼" x 1¾" capacity 0.6 ampere hours $11.75

CORE MEMORY STACKS

One of our most popular sellouts. Two types available are the 4096 words x 9 bits (36, 864 bits) easily organized as 4096 x 8 bits, and 8192 words x 4 bits (32,768 bits), manufactured by Litton Industries and RCA for Honeywell. Ideal for Minicomputors, some electronics, but no power supplies are included on the card.

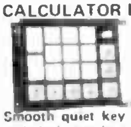
4096 x 9 Memory . . . $60.00
8192 x 4 Memory . . . $45.00

LED READOUTS

Popular OPCOA SLA-7, without decimal point. 0.27" numeral height, we formerly sold these at $4.25, and they sold extremely well. Because of a fortunate purchase we can offer them at a super-low price. Use for clocks, counters, calculators

SLA-7 Readouts $2.50

CALCULATOR KEYBOARD



This is a Flex-Key series SK keyboard made for pocket calculators. Only 2.36" x 3.76" x 0.45" thick; Switch matrix for Cal Tex 5001, 5002 or Mostek 5010 or 5012 chips. Smooth quiet key travel, double shot keys, completely sealed, impervious to dust, moisture and even direct liquid spills.

CK . . . $8.00
10 or more . . . $6.00

12 VOLT 0.750 AMPERE HOUR SEALED NICKEL CADMIUM BATTERIES

Brand new, manufactured by Gould National. Size: 1" dia. x 9-3/8" L. Manufacturer's list price is $24.50. Excellent for photo-flash, burglar alarms, etc. Fully guaranteed, available at a fraction of original cost—quantities are limited, won't last long, so order now!

12V 0.75 AHSNCB . . . $9.75

7-SEGMENT DIGITAL DISPLAY — $1.70 each

Bright blue-green display tube, with numerical display characters. Tube exhibits very fast display speed and easy-to-read characters of .57" H x .36" W, with decimal point. Complete with instructions to make a decade counting unit or a 6-digit clock. Tubes are brand new, bulk packed, and manufactured by Tung-Sol, no. 1705. Sh. Wt. 4 oz.

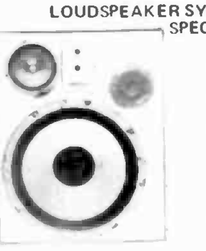
7SDD-1705 . . . $1.70 each; or 6 for $8.50, 10 for $14.00, 100 for $125.00, 1000 for $950.00

COLLINS CRYSTAL FILTERS

Anyone who is familiar with super high quality communications receivers is familiar with the Collins filter. 455 Kc center frequency 300 Hz bandwidth. Part number 526 7073 009, type X455-KF 300. Full technical information provided.

Collins Crystal Filter . . . $14.75

LOUDSPEAKER SYSTEM COMPONENT SPECIAL!



We have made an excellent purchase of an excess inventory of a local manufacturer's speaker systems, although we are not allowed to mention the mfg's. name, the specs should make it self-evident. The woofer is a 12" free-edge (acoustic suspension) unit, with 2" voice coil and a No. 2 magnet. The mid-range is a 5" sealed back speaker and 3-½" flare dome tweeter for best high frequency dispersion. Crossover between woofer & mid-range is by an R-L-C network, while high frequency crossover is by an R-C network. Balance controls are provided for both mid-range and tweeter. Plans for a suitable enclosure are provided. The level controls provide frequency response to suit room acoustics, with realism that will delight even the most critical listener. Response — 25 to 20K + Hz., Power — 40 watts RMS. Impedance — 8 ohms.

Sh.Wt.12 lbs.

- ☐ LSCS $36.00
- ☐ 2LSCS . . . . 2 for $65.00

TELSA COIL KIT

Here's a truly basic kit for those who like to "roll their own." All the parts for an exciting adventure into high-frequency, high voltage. Add your own metal housing — a small chassis or universal box is ideal.

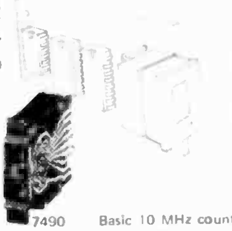
Tesla coils are patterned after the design of Nikola Tesla (1857-1943) an American electrical genius who built versions many feet tall. His dream was to light and power entire cities with energy radiated from such coils — but no luck!

Today's Tesla coils are popular with experimenters and students, and especially for science fair and educational demonstrations. Ours is a high-frequency push-pull oscillator coupled to a television flyback transformer, which steps up an external 12 VDC power supply to many thousand volts.

SPECIAL NOTE: Although current output is relatively low, some hazard is inherent in all high voltage devices. This kit is intended for the experimenter who is mature enough to observe reasonable precaution in its use.

TESLA COIL KIT $7.50

DECADE COUNTING UNITS WITH READOUTS



Always one of B & F's most popular items, now revised to include drilled boards, I.C. sockets, and right-angle socket for readout. Arranged so that units can be stacked side by side and straight pieces of wire bussed through for power, ground and reset. Several different units are available as follows:

- 7490 — Basic 10 MHz counter. Used in frequency counters and events.
- 74196 — Same as 7490 except presettable 50 MHz unit. Used where higher speed and/or presettability is required.
- 74192 — Bi-Directional Counter, 32 MHz operation. Has two input lines, one that makes the unit count up, the other down. Uses include timers, where the counter is preset to a number and counts down to zero, monitoring a sequence of events, i.e., keeping track of people in a room by counting up for entries and down for departures.
- 7475 — Adds latch capability. Used in counter so displays continue displaying frequency while new frequency is being counted for uninterrupted display.
- 7447 — Basic decoder module. Drives basic seven segment display which is included for all modules.

NEWEST DCU!

This DCU combines all of the features of our other counting units, that is, high speed counting, up-down operation, storage, and preset. In addition it includes a comparator (7485) and a thumbwheel switch in order to provide comparison and preset capability. With this combination you can do the following:

1. Count up or down at speeds to 33 MegaHertz.
2. Store previous count during new count.
3. Preset to any number, count down (or up) and generate a logic level when count of zero is reached. Stack several units and generate logic level for any count greater than zero.
4. Preset to zero, count up (or down) and generate a logic level for any number greater or equal to the number preset in the thumbwheel switch. Stack several DCU's and generate a logic level showing whether number is greater than, equal to, or less than numbers preset on switches.

- ☐ 910 K — 7490-7447 Counter $8.25
- ☐ 910 LK — 7490-7475-7447 Counter $9.25
- ☐ 911 LK — 74196 7475-7447 Counter $10.25
- ☐ 912 K — 74192 7447 Counter $9.25
- ☐ 913 K — 74192 7475-7447-7485 Universal DCU $14.50

I.B.M. POWER SUPPLY REGULATOR PARTS!

Like-new assembly surplus from the I.B.M. Company contains the following: (6) 150-Watt transistors, (6) heat sinks, (6) .1Ω 5W resistors, 12V, 20 Amp circuit breaker, a 16-ohm 10-Watt resistor, 50-Watt resistor, terminal strip, (2) 16-pin P.C. edge connectors for regular cards. An 8000 mfd, 15V computer grade capacitor is also provided. All in a nice mounting — looks as if it could be a neat unit to make a lab-type power supply. Unit is sold as an assembly, or in parts. Quantity is limited.

Sh.Wt. 20 lbs.	IBMPSRA	$7.50
3 for $20.00	IBMPSRA	$20.00/3
8 for $52.00	IBMPSRA	$52.00/8

Heat sinks capable of dissipating 150 watts of power

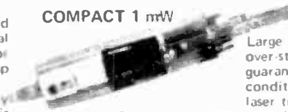
Price . . . . $1.00 ea.
Transistors, 2N441 or 2N442 type, TO-36 case . . . $1.00 ea.
Heat sink with transistor . . . . $1.50 ea.
4 for $5.00 . . . . $5.00/4
Connectors, 2 for $1.50 . . . . $1.50/2
Capacitor, $1.50 . . . . $1.50 ea.

HEWLETT PACKARD SOLID STATE NUMERIC INDICATOR

These fantastic L.E.D indicators have built-in decoder/driver with memory. They use a 4 x 7 dot array for much better readability. They are packaged in a standard Dual-In-Line (DIP) package with built-in contrast filter. Completely DTL TTL compatible. HP part number 5082-7300 (right hand decimal)

HP 5082 . . . . $9.75

COMPACT 1 mW LASER TUBE



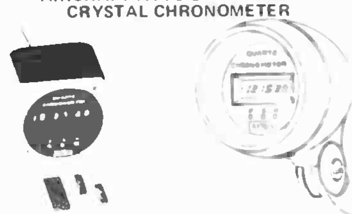
Large manufacturer sells his over-stock tubes to us, all guaranteed to be in perfect condition. Most compact 1mW laser tube (TEM.) on the market, only 8-½" long, uses a special tapered bore design, unique in the industry. Cavity design, internal hemispherical mirror system with co-axial mounting of all elements, maintain beam alignment and power stability under mechanical stress and changes in temperature. SPECIFICATIONS: red laser, 1mW power, TEM., 632.8mm wavelength, 1.10mm beam diameter. 0.85 mrad divergence, linear polarization, size. 8.5 x 1.75" diameter. These can be useful for alignment systems, measurement systems, and for illumination, etc., in equipment such as levels, transits, ranging, inspection displays, holography, etc. Operation life beyond 10,000 hours. This is not a toy tube, but a laser designed to meet rigid industry standards. List price is over $200.00 each.

Sh.Wt. 3 lbs.	C1mWLT	$97.50
2 for $180.00	C1mWLT	$180.00/2
10 for $850.00	C1mWLT	$850.00/10
100 for $7500	C1mWLT	$7500.00/100

Portable supply—operates from 12 vdc input. Useful for field experiments with laser. Available only with purchase of tube.

Price $25.00

AIRCRAFT AUTO BOAT QUARTZ CRYSTAL CHRONOMETER



Revolutionary!, was the reaction of our customers when they saw our latest kit. Measuring only 2½" x 2½" x 23/8", and accurate to 10 seconds a month, this chronometer promises to entirely replace mechanical clocks in cars, boats and airplanes.

Fits into a standard 2¼" instrument panel cutout. The displays are bright L.E.D. displays that should last a lifetime. Setting controls are recessed and operate from a pointed object such as a pencil point or paper clip, in order to keep non-authorized hands off. The clock should only have to be reset at very great intervals, or in the event of power loss (i.e., replacing battery in car). The clock is wired so that the timing circuits are always running, but the displays are only lit when the ignition is on, resulting in negligible power drain. The low price is only possible because of a new one chip MOS clock. Operates from 10-14 Volts D.C. An accessory unit which mounts on the back adapts the unit 59 20-28 volts for twin engine aircraft and larger boats using 24 Volts ignition. Know how disgusted you are with the usual car clock? Order this fine unit now for rallying, sports events, navigation, or just to have a fine chronometer that will give you a lifetime of superbly accurate time.

- ☐ Quartz Chronometer, Kit Form $69.50
- ☐ Quartz Chronometer, Wired $99.50
- ☐ 24 Volt Adapter $10.00

New-Style AUTO/BOAT/PLANE QUARTZ CRYSTAL CHRONOMETER

As you can see from the illustration, we have provided a new enclosure for our most popular kit, the ARIES Model AR-720K Quartz Crystal Chronometer. This enclosure can be mounted in many convenient variations, i.e., over or under the dashboard, over the center drive tunnel, or under the roof above the windshield.

- ☐ Automotive style quartz crystal chronometer $75.00
- ☐ Same assembled, calibrated, tested $99.00

Send in an order and get on our special custom customer Mailing List.

CATALOG: Check reader's card or write.

ALL ITEMS (WHERE WEIGHT IS NOT SPECIFIED) POSTAGE PAID IN THE U.S.A.

CHARGES WELCOME!

Phone in charges to 617 531-5774 or 617 532-2323. BankAmericard — Mastercharge. $10.00 minimum. No C.O.D.'s please.

B.&F. ENTERPRISES Mass. 01960
Phone (617) 531-5774
119 Foster Street
Peabody, Mass. 01960

Circle 82 on reader service card

ADVERTISING INDEX

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

MORE BARGAINS IN SURPLUS ELECTRONICS from B & F ENTERPRISES

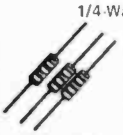
Just off the press our Best Catalog yet with 104 Illustrated pages of surplus Electronics, Optics, and Much More...

DIGITAL CLOCK CHIP

These large scale integrated (LSI) chips eliminate 14 to 20 MSI TTL chips in the design of an electronic clock. Features 12 or 24 hour operation, 6 digits, internal multiplexing, operated on 50 or 60 Hz input, or a schematic is provided for crystal control. Logic gates between the counter allow setting at the rate of one hour digit per second, or, one minute digit per second. A "hold" input allows stopping the chain. The multiplexer samples the outputs of the hours, minutes and seconds counters (in the six digit model), routing this data to a programmable read only memory (ROM), which is programmed to provide BCD and seven segment outputs. All outputs are compatible with bipolar devices, necessitating few external components for the display interface. Only one power supply is required for operation.

1. 5314 chip (24 pin plastic) used for 7 segment displays such as LED's, numitrons, minitrons and Sperry displays. Price $9.95
2. 5311 chip (28 pin ceramic) includes BCD output to above for interface to nixies, computer inputs, etc., in addition to 7 segment outputs. Price $14.95

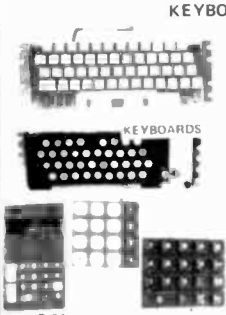
1/4 Watt RESISTOR ASSORTMENT!!



Brand-new 5% tolerance resistors, individually bagged 5 to a bag, each bag marked with values. 70 different values, 10 ohms to 10 megohms in a 1 : 1.5 : 2.2 : 3.3 : 4.7 : 6.8 : 1 sequence. A complete laboratory supply of resistors at less than 5 cents apiece.

Sh.Wt. 2lbs.	¼WRA	$15.00
4 bags for $55.00	¼WRA	$55.00/4

KEYBOARDS:



Teletype format ASCII coded keyboard, with parity check line (see fig. A). Coding is by means of a built in diode matrix, which can be modified from ASCII by inserting or removing diodes. Keys are 26 characters, all numbers, plus shift, ctrl, alt, line feed, car return, rept, brk, rub nut, here is, and usual typewriter symbols. Mfr controls research and microswitch. Requires +5 volts, uses DTL circuitry, compatible with DTL or TTL. 52 keys, 3 integrated circuits, about 200 diodes. Brand new, guaranteed. 15 pin connector on 10" cable.

KB-01 .... $44.50

Non-decoded alphanumeric keyboard, Figure "C", single form, SPST contact on each key.

KB-3 .... $24.50

Figure "D", calculator keyboard in calculator case, pressure sensitive elastomer contacts, manufactured for Arles.

KB-4 .... $9.50

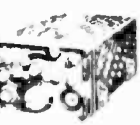
Touch-tone keyboard, Figure "E", manufactured by Chromerics. No electronics included.

KB-5 .... $9.00

Desk calculator keyboard, Figure "F", manufactured by Controls Research.

KB-6 .... $15.75

RT 270A/GRC TRANSCEIVER



This is a prime government surplus item, until recently in scarce supply and selling for hundreds of dollars. Consists of a double conversion FM superhetrodyne receiver and a FM transmitter linked thru a common antenna circuit. Range is 47 to 58.4 mHz continuous. Size is 7-3/8 x 4-3/16 x 12-15/16. Built-in calibrator and heat oscillators permit fast alignment.

RT 270A/GRC
New, including 1 mHz crystal $35.00

RT 2700A/GRC
Used, excellent, less crystal $20.00

*** 1 mHz crystal only $5.00

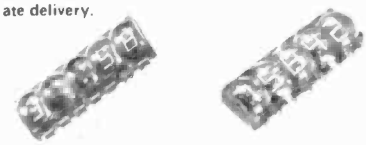
TRANSISTORIZED FLUORESCENT CAMPING/EMERGENCY LIGHT KIT!

This transistor inverter powered camping and emergency light will provide a bright portable light from a 12-Volt D.C. battery. A cigarette lighter adapter is provided for automotive operation, or the unit may be run from other 12-Volt lantern batteries. The advantages of this unit over more conventional incandescent lamps is the vastly greater light output for equivalent power input and the superior distribution and color of the light.
The camping/emergency light is enclosed in a weather-tight plexiglas tube, with the electronics built into the tube. Completion time should be less than two hours, making it a nice evening's project, even for the beginner.

Sh.Wt. 3 lbs.	TFCELK	$12.50

ATTENTION MANUFACTURERS – LED RIOT!

B & F has bought over 500,000 7-segment LED numeric displays and over 1,000,000 LED lights. These are available in manufacturing quantities for immediate delivery.



5082 – 7400 SERIES DIGITS FROM HEWLETT PACKARD

Hewlett Packard, one of the world's largest manufacturers, has sold us his surplus of multiple digit clusters with one bad digit per cluster. They were for use in the HP35 calculator, 970A DVM, and other products. The remaining digits are guaranteed perfect in all respects and are intensity graded (marked on the back with letters A thru F) and matched, so that several strips can be combined and still result in a perfect match. These monolythic GaAsP displays require as little as 7 mW per digit, are highly readable at arm's length, and lend themselves well to hand-held portable applications.

Applications include hand-held calculators, digital thermometers, stopwatches, darkroom timers, DVM's, clocks and watches, or any other product requiring low cost, low power, long lifetime indicators.

The unit is common cathode, set up for multiplexed operation. Two decimal point styles are available; center decimal for PN 7804/05, and right decimal for PN 7814/15, as illustrated. The following configurations are available, where "8" represents a perfect digit, "X" a non-functioning digit:

X8888	7405-1 or 7415-1.	X888	7414-1
8X888	7405-2 or 7415-2.	8X88	7414-2
88X88	7405-3 or 7415-3.	88X8	7414-3
888X8	7405-4 or 7415-4.	888X	7414-4
8888X	7405-5 or 7415-5.	X88X	7556-1

All products are available at the following price rate:

1 – 24 digits ... $1.875/digit
25 – 99 digits ... $1.50/digit
100 – 499 digits ... $1.25/digit
500 – 999 digits ... $1.00/digit

Higher quantity price on request.

For the following applications we recommend the following configurations:

Pocket calculators: 7405-1 & 7405-5, which results in X88888888X, eight consecutive perfect digits @ $1.875 = $15.00.

Recommended Calculator chips:

Nortec 4204 @ $19.75 ($15.00 when ordered with displays). Caltex 5005 @ $9.75 ($7.50 when ordered with displays).

Clocks: 7405-3 & 7556-1, which results in 88X88X88X, six perfect digits at $1.875 = $11.25.

Recommended clock chips:

National MM5314 @ $9.75 ($7.50 ordered with displays). National MM5316 @ $19.75, includes alarm, ($15.00 ordered with displays).

For only hours and minutes, order 7405-3 only.

Digital thermometers, DVM's, stopwatches, darkroom timers, frequency counters, etc., order 7415-1 or 7415-5 for four digits ($7.50) or 7414-1 or 7414-4 for three digits ($5.60). Use Solitron CM 4102AE 3½ digit counter decoder @ $19.00.

($15.00 ordered with displays).

Schematics for calculators, clocks and counters using these components free with order.

LED SOLID STATE LAMPS

Plastic encapsulated gallium arsenide phosphide light emitting diodes. Designed for low power consumption, as low as 5 milliwatts. Red diffused lens.

10 pcs. ... $2.00 100 pcs. ... $15.00
1000 pcs. ... $100.00

Higher volume prices on request.

SUPER QUALITY I.C. SOCKETS

Sockets made by T.I. and Cinch. All are low-profile, compact types.

14 Pin Dip Solder Tale Sockets
3 for $1.25 16 for $5.00
16 Pin Dip Solder Tale Sockets
2 for $1.00 13 for $5.00
14 Pin Dip Gold Wire Wrap Socket
2 for $1.25 10 for $5.00
16 Pin Dip Gold Wire Wrap Socket
2 for $1.50 8 for $5.00
10 Pin to 5 Gold Sockets (Cinch)
2 for $1.00 13 for $5.00

Now available 24, 28 & 40 Pin sockets Only $1.00 ea.

October 2, 1973

Dear Customers,

Due to a variety of circumstances in past months, some customer orders, refunds and exchanges have been lost or otherwise snafu'd. I would like to take this opportunity to point out that we have now solved our internal difficulties to the point where we can and will take immediate action on any such complaints. Any customer having any problem can be assured prompt action by writing to Ms. Lynn Chafey, Customer Relations Director, B & F Enterprises, 119 Foster St., Peabody, Massachusetts, 01960.

Without making excuses, I think some of you readers might be interested in the changing nature of the "surplus" business, which I believe we were instrumental in changing. In early 1970 electronic manufacturers were in the doldrums, due to the changeover from military to commercial business. Items (particularly TTL integrated circuits and other semiconductor items) were sold to original equipment manufacturers, (OEM's) at a fraction of catalog price, to stimulate business. This prompted us to negotiate directly with manufacturers for large quantities of items at low cost, and to offer these to hobbyists and electronic experimenters who buy in small quantities, at a fraction of catalog price. This was the experiment that revolutionized the surplus business, and we became more "cut-rate distributors" than "surplus dealers".

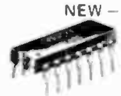
There were some problems, though. First, the commercial business took a wild upswing, and manufacturers who were begging us to accept products suddenly found they couldn't supply enough material, and deliveries became slow or nonexistent. Second, with slow deliveries, the amount of paperwork and handling to ship orders in two or three partial shipments became overwhelming. With a small mark-up on sales, it simply was impossible to devote much time to correspondence. Third, quite frankly, was that Pete and myself as engineers, were not used to the problems of inventory control, and shipping management. In a period of time when our sales were tripling every year, we had trouble keeping up with the greatly increased sales.

At the present time, I truly believe we have our problems solved, and can offer our customers both good service and low price. We have been shipping all stock items within 48 hours. We have refrained from advertising any items not in good inventory. And our rate of growth, while still good, is at a sufficiently slow pace now so that we can solve problems as we encounter them. As a parting word, I would like to say that we are interested in getting feedback from readers on other matters. What would you like to see us carry? We welcome any other comments that will help us improve service. Thank you in advance.

Very truly yours,

Franklin G. Fink, Partner
B & F Enterprises

NEW – COSMOS INTEGRATED CIRCUIT



Said to be the "New Wave" in integrated circuits of the future. Ultra low power drain (microwatts)

☐ 4000AE	Dual 3 Input Nor & Inv	$ .99
☐ 4001AE	Quad 2 Input Nor	$ .99
☐ 4002AE	Dual 4 Input Nor	$ .99
☐ 4006AE	18 Stage Static Shift Register	$4.99
☐ 4007AE	Dual Complementary Pair & Inv	$ .99
☐ 4009AE	Hex Buffer, Inverting	$2.19
☐ 4010AE	Hex Buffer, Non Inverting	$2.19
☐ 4011AE	Quad 2 Input Nand	$ .99
☐ 4012AE	Dual 4 Input Nand	$ .99
☐ 4014AE	8 Stage Static Shift Register	$5.99
☐ 4017AE	Decade Counter W/Decoder	$5.99
☐ 4020AE	14 Stage Binary Ripple Counter	$5.99

Send in an order and get on our special customer Mailing List.

CATALOG: Check reader's card or write.

ALL ITEMS (WHERE WEIGHT IS NOT SPECIFIED) POSTAGE PAID IN THE U.S.A.

CHARGES WELCOME!

Phone in charges to 617 531-5774 or 617 532-2323. Bank Americard – Mastercharge. $10.00 minimum. No C.O.D.'s please.

B.&F. ENTERPRISES Mass. 01960
Phone (617) 531-5774
119 Foster Street
Peabody, Mass. 01960

Circle 82 on reader service card

The Timesaver!

Latest, all solid state version of the sensational signal circuit analyzing timesaver originated by Castle.

Invaluable for locating the break in the tuner and i.f. signal chain or analyzing agc system defects in tube TV receivers . . . essential for speedy location of signal circuit defects in modular IC, solid state and hybrid TV receivers.

A NEW APPROACH to agc system analyzing!

Permits signal injection after the agc controlled stages to simplify testing for agc defects.

- Works with any 40MHz receiver . . . color or black and white . . . solid state, tube or hybrid.
- High level, low impedance output furnishes signal usable at input of final i.f. stage.
- Special output circuit works equally well into first i.f. input of late model, link coupled systems and older, low "C" bandpass coupled systems.
- Antenna input and i.f. output electrically isolated; no "hot" chassis hazards.
- No need to disconnect supply leads from suspected tuner being tested. Substitutes the VHF tuner and tests the UHF tuner.
- Tunes all 12 VHF channels, has preset (memory) fine tuning on all channels.
- Higher overall gain than previous models with wide range gain reduction control of 60db.
- Completely self contained and battery operated, uses popular batteries available everywhere. Simple battery replacement; battery compartment in rear of custom molded case.
- Reduced current consumption extends battery life to as much as double that of previous models. Bright LED indicator warns when unit is ON.
- Use on the bench or in the home . . . anywhere.
- Comes complete with extension cables, batteries and instructions.

Specifications

Inputs:	300 ohms balanced VHF antenna terminals, electrically isolated. 75 ohms 40 MHz amplifier (Ch. 01) RCA phono jack.
Sensitivity:	30 microvolts. Input signal handling capability: over 100,000 microvolts.
Output:	40 MHz TV i.f.: bandwidth 6 MHz. "Mastermatchcoupler" output circuit with matched cable to furnish usable signal for all input circuits. Termination is RCA phono jack, electrically isolated.
Tuning Range:	All 12 VHF TV channels, plus Ch. 01 40 MHz amplifier position for testing UHF tuners. High stability of 40 MHz amplifier permits two Mk. IV Subbers to be cascaded for high level 40 MHz output signal from any VHF channel.
Tuning:	Preset (memory) fine tuning.
Gain Control:	Gain reduction 60 dB.
Power supply:	18 volts. Uses two 9v transistor batteries.
Size & Weight:	6.5"x 6.5"x 3.25" exclusive of control knobs and handle. 1.5 lbs complete with batteries.
Accessories:	"Mastermatchcoupler" output cable with RCA phono jack termination. "Mastermatchcoupler" output cable with alligator clip terminations. UHF tuner test cable.

TV TUNER SUBBER*™ *Mark IV net $45.95

Contact your distributor

CASTLE TV TUNER SERVICE, INC.

5715 N. Western Ave., Chicago, Illinois 60645 • Phone: (312) — 561-6354

In Canada: Len Finkler Co., Ontario

Circle 80 on reader service card