SPECIAL ISSUE
COLOR TV 1970

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Anti X-Ray Circuit

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1970 CBS Direct Marketing Services
The top-priority crash programs initiated by all color TV receiver manufacturers to eliminate any possibility of X-ray leakage are already having their effect on current products, an industry-wide survey shows.

The new federal X-ray standards for color sets provide for a gradual tightening of the formerly voluntary radiation limits. Phase 1 of the new regulations gives force of law as of Jan. 1, 1970—to the limit of 0.5 milliroentgen (mR) per hour at any point 5 cm from the surface of the receiver, but adds the condition that measurements must be made with a line voltage of 130 and all user controls set to produce maximum radiation. Phase 2, in effect June 1, 1970 stipulates that the 0.5-mR limit must be observed with all service controls set to produce maximum radiation. Phase 3, as of June 1, 1971, maintains the 0.5-mR limit, but adds simulated failure of components to produce maximum radiation.

We asked all major color TV receiver manufacturers what they were doing to hold down radiation, and most responses made it clear that they feel that they already meet the Phase 2 requirements and hope to be observing the Phase 3 conditions long before the deadline.

All chassis redesign efforts are directed toward the three potential radiation-producing components—the picture tube, the high-voltage rectifier and the shunt regulator. The former should soon cease to pose a problem, since all domestic picture tube manufacturers are now phasing into their product a new glass formulation containing strontium and providing five times more radiation absorption than the former formula which contained barium as the X-ray blocking element.

While manufacturers chose to stress different aspects of their anti-radiation programs, the following summary of replies to our survey gives a good representation of the progress made in the industry-wide war against X-ray leakage.

Admiral—Sets are designed to operate considerably below the recommended 0.5-mR limit. Receivers are checked for radiation during production and after leaving the production line. The designs and sets are also monitored by outside agencies, including Illinois Institute of Technology Research Institute and Nuclear-Chicago, whose reports confirm that the sets operate well within the limits under high line voltage conditions.

Service dealers and technicians have been instructed to ascertain that all shielding is in place, and they automatically check high voltage with a special meter on every service call.

Zenith high-voltage limiter uses power tetrode to sample B-boost and flyback pulse and load the damper circuit to reflect a constant load on the horizontal sweep. VDR improves regulation with changes in load. G-E circuit (right) is similar to do-it-yourself circuit on page 68.

Andrea—At press time was conducting trial-run tests of a new color chassis with an Andrea-developed hold-down circuit designed to assure that high-voltage failure does not result in radiation beyond acceptable limits. Upon successful completion of the test, Andrea will incorporate this safety device in all models as quickly as possible.

Emerson—Declines to list specific steps taken but says its sets never have exceeded specified X-ray limits and that the company is making whatever improvements are required to be certain that excessive radiation is impossible.

General Electric—GE's long-term anti-X-ray programs include: (1) Pioneering design of color sets operating at lower voltages and using fewer components capable of producing radiation. (2) Improved high-voltage rectifier and shunt-regulator tubes having rigid X-ray controls and published specifications. (3) Introduction of improved high-voltage hold-down circuits using redundant components to further insure reliability. (4) Advanced shielding techniques. (5) A reduced range of high-voltage adjustment. (6) A series of instructional courses to teach service technicians proper procedures and practices.

Among GE's improved design and manufacturing techniques: (1) Thicker, higher-lead-content regulator and rectifier tube envelopes. (2) Thicker or improved anode and shield designs. (3) Unique basing arrangements on new tubes to eliminate use of older types as replacements. (4) Close supervision of suppliers' products. (5) Special cleaning processes for component parts. (6) Improved high-voltage aging. (7) Improved internal quality control and test procedures. (8) New automatic radiation test which accommodates larger samples, employing circuitry developed by the Department of Health, Education and Welfare. Sets have been designed not to exceed the 0.5-mR level even under most conditions of misadjustment.

Magnavox—Has recently added a new type of hold-down circuit which causes high voltage to decrease rather than increase if the shunt regulator fails. Example: In a typical set operating at 130 volts line and with all controls misadjusted to give maximum high voltage, the voltage will be 27 kV. With the shunt regulator pulled out, the voltage drops to about 22.5 kV. Improved shielding is tested with special shunt regulators radiating as high as 300 mR and rectifier tubes at 80 mR (Magnavox's normal limits are 2 mR for both)—yet no radiation is detectable outside the high-voltage cage.

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Other Magnavox precautions: (1) Radiation is continuously measured on finished products coming off the production line both in normal operation and at 130 volts line with shunt-regulator circuit defeated, and at varying picture tube beam currents. (2) CRT X-ray measurements are made both before and after continuous life testing. (3) Suppliers must submit products for systematic and in-depth radiation studies by the company's Engineering Section. (For example, Magnavox will accept no high-voltage rectifier or shunt-regulator tubes unless the glass contains 49% lead.) This program has resulted in the rejection of several foreign and domestic components which did not meet the company's standards. (4) Service technician warnings against removal of shielding and on voltage adjustments are posted within each receiver, as are additional notices advising of radiation precautions to protect the technician.

In its production facilities, all color TV workers wear film badges to determine their exposure to radiation. The observed readings have been only slightly above the normal exposure from natural background sources. Lead shielding has been added to all test fixtures which could possibly radiate.

Motorola—Was the first domestic set manufacturer to use a solid-state high-voltage rectifier in color sets, eliminating the possibility of radiation from this component. The solid-state rectifier is now being phased into the entire line as rapidly as possible. Other safeguards: (1) Several years ago, Motorola eliminated the shunt regulator from its sets. (2) A new radiation-reducing high-voltage rectifier is being used in tube-chassis sets. (3) Shielding has been redesigned and its use increased. (4) High-voltage control has been made virtually inaccessible to the service technician, so that adjustment beyond design limits is unlikely without removing part of the chassis. (5) Prominent labeling, adjacent to the high-voltage control and on the high-voltage cage, warns technicians against misadjustment and against servicing the set without shielding in place.

Design and verification: Receivers are designed to radiate considerably under the 0.5-mR standard. New designs are tested and verified by an outside radiology consultant. The company's Safety Engineering Group tests for radiation all receivers from engineering pilot runs, production pilot runs and from initial production, as they come off the line and in extensive life tests.

For the protection of production personnel, all component test positions are shielded where necessary and all positions monitored for radiation regularly. X-ray detection badges are used by employees in all areas where high voltage is present. As part of its technician information program, radiation precautions are covered by Motorola regional service technicians and technical representatives who instruct some 17,000 technicians per year.

Packard Bell—Expects to comply with the Phase 3 standard at least a year before it goes into effect. Modifications already made in the 1970 line: (1) Fail-safe component-failure protection. (2) Limiting of high-voltage control to a narrow range, making it impossible to exceed standards. (3) Redesigned and improved shielding. Very specific instructions have been sent to service personnel. Factory-owned service branches send technicians out to recheck sets when customers call in with concern about X-rays. A rigorous factory quality-control program has been instituted.

Philco-Ford—Has established a Safety Committee, whose duties include X-radiation policy. For the last two years, Philco's sets have not included shunt regulators. Prototypes, engineering samples and pilot production sets get rigid tests before production okay is given.

During assembly, all shields are put in place before any power is turned on. Quality Control Department makes certain that safety precautions are observed before power is applied. Under power, the receiver is adjusted to the correct high voltage and is subject to continuous monitoring. After the picture tube has been converged and before the back is put on, the set is checked again, the voltage readjusted if necessary, and sealed with tape. The high-voltage cage is labeled with the precise setting to guide the technician. A percentage of sets are removed from the storage warehouse and put through a complete quality audit, including X-ray check. The company publishes instructions and guidelines for technicians and informs them of any new developments relating to previous models.

RCA—Chassis developments: (1) High-lead-content bulbs are used for the high-voltage rectifier tube. (2) A special shield is used in the rectifier socket. (3) The rectifier enclosure is made of cold-rolled steel. (4) A taller shunt-regulator shield is used. (5) All unnecessary holes are eliminated in the rectifier and regulator compartments. (6) A hold-down circuit is used to control the high-voltage levels should the regulator fail. (7) Solid-state high-voltage regulators and rectifiers are used in some sets. (8) A precision resistor divider is used to eliminate any chance of misadjustment during servicing. (9) The solid-state chassis has a limited voltage-adjustment range as well as a line-regulated B+ system which prevents high voltage from rising with line-voltage increases.

Production and quality control: Before a receiver is shipped, it is subjected to several production-line radiation checks. The high voltage is the first and last item checked. The hold-down circuits are checked during chassis alignment to assure proper operation. Two percent of the production is given an exhaustive check under high line-voltage conditions and various brightness settings. If any sets are found exceeding 30% of the 0.5-mR limit, a hold is put on all sets of that type until the reason has been found and corrected.

Servicing: RCA supplies information about high voltage and X-radiation in every set's service manual. It attaches warning labels to every set in conspicuous locations. It conducts training sessions and workshops for service personnel in which good servicing techniques regarding radiation are stressed.

Sylvania—Current chassis: (1) Careful shielding of the high-voltage rectifier and shunt-regulator tubes with extra-thick metal and by the mounting position. A hinged lid minimizes the possibility of X-ray exposure during servicing. (2) X-ray-absorbing glass is used in the high-voltage rectifier, shunt regulator and picture tube. (3) Hold-down circuits prevent high voltage from rising...
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COMMISSION SAYS TV SETS CAUSE FIRES

WASHINGTON—The National Commission on Product Safety recently reported that some 10,000 fires are started each year by TV sets, even when they may be turned off.

Although not spelled out in commission reports, the usual cause for such fires are voltage surges that may short out bypass capacitors across the ac line. Manufacturers have been recommending in service notes that technicians increase the voltage ratings of these capacitors. Similar capacitor failures in other appliances have caused the same problem.

The commission's estimate was based on a spot check of fires caused by TV sets around the country, including an estimated 361 in New York City in 1968.

Blame for a number of the fires was placed on insulation failure in the high-voltage section of color sets, where temperatures up to 150° and 25,000-volt potentials can be hazardous.

Audio is sampled by an encoder and converted to a delta-modulated pulse train at 16 times the horizontal line frequency (15, 750 Hz.). The coded signal is compressed and gated into the normal satellite channel. Audio was revealed at the International Electronics Conference here in October.

The technique was developed by the Northern Electric Laboratories in Ottawa as a means of reducing costs and the complexity of transmitting video and audio TV signals separately. Audio is usually routed on separate radio channels or land lines, while the video is transmitted by microwave. The company is anticipating use of satellites to reach remote areas in Canada.

LOW-COST CASSETTE COLOR VTR

A cassette-cartridge vtr playback machine (photo) costing only $350 when marketed late this year has been introduced by Sony Corp. A $100 add-on adapter will enable black-and-white or color programs to be recorded and played back from $20, 90-minute video cassettes.

Resolution of the machine is reportedly 300 lines for b-w and 250 lines for color. The 34-inch tape runs at just over 3 ips.

Panasonic has also announced a cassette-type vtr with color capabilities to be on sale by 1972. High-speed duplication techniques will provide mass-produced pre-recorded tapes for entertainment and training.

Also shown by Panasonic is a reel-type vtr that uses regular 1/2-inch tape instead of 1-inch tape for recording color. An automatic phase control circuit stabilizes color images by automatically compensating for phase and frequency shifts.

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Audio-Video Diplexing for Satellite TV

TORONTO—A technique for diplexing the audio and video portions of TV programs for transmission over a single satellite channel was revealed at the International Electronics Conference here in October.

The technique was developed by the Northern Electric Laboratories in Ottawa as a means of reducing costs and the complexity of transmitting video and audio TV signals separately. Audio is usually routed on separate radio channels or land lines, while the video is transmitted by microwave. The company is anticipating use of satellites to reach remote areas in Canada.
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*Selector shaft length measured from tuner front apron to extreme tip of shaft.

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When you enroll with NRI we deliver to your door everything you need to make a significant start in the Electronics field of your choice. This remarkable, new starter kit is worth many times the small down payment required to start your training. And it is only the start... only the first example of NRI's unique ability to apply 50 years of home-study experience to the challenges of this Electronics Age. Start your training this exciting, rewarding way. No other school has anything like it. What do you get? The NRI Achievement Kit includes: your first set of easy-to-understand "bite-size" texts; a rich, vinyl desk folder to hold your training material in orderly fashion; the valuable NRI Radio-TV Electronics Dictionary; important reference texts; classroom tools like pencils, a ball-point pen, an engineer's ruler; special printed sheets for your lesson answers—even a supply of pre-addressed envelopes and your first postage stamp.
ELECTRONICS COMES ALIVE AS YOU LEARN BY DOING WITH CUSTOM TRAINING EQUIPMENT

Nothing is as effective as learning by doing. That's why NRI puts so much emphasis on equipment, and why NRI invites comparison with equipment offered by any other school, at any price. NRI pioneered and perfected the use of special training kits to aid learning at home. You get your hands on actual parts like resistors, capacitors, tubes, condensers, wire, transistors and diodes. You build, experiment, explore, discover. You start right out building your own professional vacuum tube voltmeter with which you learn to measure voltage and current. You learn how to mount and solder parts, how to read schematic diagrams. Then, you progress to other experimental equipment until you ultimately build a TV set, an actual transmitter or a functioning computer unit (depending on the course you select). It's the practical, easy way to learn at home - the priceless "third dimension" in NRI's exclusive Electronic TV-Radio training method.

SIMPLIFIED, WELL-ILLUSTRATED "BITE-SIZE" LESSON TEXTS PROGRAM YOUR TRAINING

Lesson texts are a necessary part of training, but only a part. NRI's "bite-size" texts are as simplified, direct and well-illustrated as half a century of teaching experience can make them. The amount of material in each text, the length and design, is precisely right for home-study. NRI texts are programmed with NRI training kits to make things you read come alive. As you learn, you'll experience all the excitement of original discovery. Texts and equipment vary with the course. Choose from major training programs in TV-Radio Servicing, Industrial Electronics and Complete Communications. Or select one of seven special courses to meet specific needs. Check the courses of most interest to you on the postage-free card and mail it today for your free catalog.

custom training kits "bite-size" texts

Available Under NEW GI BILL
If you served since January 31, 1955, or are in service, check GI line in postage-free card.
Here's A Little Item That Will Get You Out Of Many A Tight Spot

HANDLE ONLY 3¾" LONG—
18 Degree Working Arc.

Stainless steel Midget Ratchet handle, 17 Drivers, ¾" extension, two slotted and two Phillips bits, 12 hexagonal bits from 0.050 to 5/16", one square adapter for ⅜" wrench sockets—all in pocket-sized vinyl case.

You may purchase from your local Supply House or direct from
THE CHAPMAN MANUFACTURING CO.
Manufacturers of Midget Ratchet Offset Screwdrivers for over 25 years.
10 Saw Mill Road, Durham, Conn. 06422

Circle 10 on reader service card

EIGHT INSTRUMENTS IN ONE

- Out-of-Circuit Transistor Analyzer
- Dynamic In-Circuit Transistor & Radio Tester
- Signal Generator
- Signal Tracer - Voltmeter
- Milliammeter
- Battery Tester
- Diode Checker

Transistor Analyzer Model 212
Factory Wired & Tested $21.50
Easy-To-Assemble Kit $14.50

YOU DON'T NEED A BENCH FULL OF EQUIPMENT TO TEST TRANSISTOR RADIOS! All the facilities you need to check the Transistors themselves—and the radios or other circuits in which they are used—have been ingeniously engineered into the compact, 6-inch high case of the Model 212. It’s the Transistor radio troubleshooter with all the features found only in more expensive units. Find defective Transistors and circuit troubles speedily with a single, streamlined instrument instead of an elaborate hook-up.

Features:
Checks all transistor types—high or low power. Checks DC current gain (β) to 200 in 3 ranges. Checks leakage. Universal test socket accepts different base configurations. Identifies unknown transistors as PNP or NPN.
Dynamic test for all transistors as signal amplifiers (oscillator check) or in a circuit. Develops test signal for AF, IF, or RF circuits. Signal traces all circuits. Checks condition of diodes. Measures battery or other transistor-circuit power supply voltages on 12-volt scale. No external power source needed. Measures current drain or other DC currents to 80 milliamperes. Supplied with three external leads for in-circuit testing and a pair of test leads for measuring voltage and current. Comes complete with instruction manual and transistor listing.

Looking Ahead (continued from page 4)

exceeding 30 kV in case of shunt-regulator failure or misadjustment. Sylvania says other major manufacturers have adopted its patented circuit.

In new chassis, due later this year: (1) High-voltage tripler, replacing rectifier, will eliminate that potential radiation source. (2) Fail-safe voltage hold-down circuit will keep high voltage below 30 kV at all times, making it impossible to exceed X-ray limit from the picture tube.

Warwick Electronics (Sears)—(1) Uses only those rectifiers and regulators in which radiation is held to the lowest possible amount. (2) Achieves double protection by improved shielding of both tubes. (3) Redesigned circuits have eliminated the high-voltage adjustment, largely through use of more precise components. (4) A voltage hold-down circuit is used. (5) Solid-state circuits are under development to eliminate all sources of radiation except the picture tube. (6) Warwick has conducted tens of thousands of checks on its receivers in production plants to insure that they produce minimum radiation. (7) Programs and procedures have been established to assure that all future designs either eliminate radiation completely or hold it to the lowest possible point.

Zenith—Engineering design: (1) A pulsed voltage regulating system, in use for several years, eliminates the major source of radiation and minimizes potential radiation from other components by achieving greater reliability of the regulator tube and associated parts. (2) A new circuit in current models reduces the possibility of excessive high voltage in case of regulator failure. (3) The voltage-adjustment range has been narrowed through use of close-tolerance components. The control has been changed to a type which cannot be accidentally misadjusted. (4) Greater built-in shielding and improved external shielding have been added to high-voltage rectifier tubes. Zenith is using an improved rectifier tube and is supplying improved regulator tubes as replacements for older color sets in use.

A company-wide committee of top engineering, scientific and medical personnel constantly reviews Zenith’s programs, which cover design, manufacture, quality assurance and testing, field service training, and monitoring of all production areas. Zenith’s quality control test programs confirm that any radiation present is far below the permitted limit. These programs are an integral part of daily production, and results are checked by radiological consultants. The company has trained thousands of service technicians in special radiation safety procedures, and keeps them constantly informed in special training bulletins and sessions.

New & Timely (continued from page 6)

horizontal sync pulse interval for transmission. At the receive end, the coded signals are detected, stored in a register and decoded into the original audio signal.

Prototype diplexing gear for the experimental process is shown undergoing tests.

RAPID RECHARGING

Los Angeles—Nickel-cadmium batteries can now be recharged in minutes instead of hours with a new charging technique developed by McCulloch Corp. The battery is short-circuited for microsecond intervals in between a series of very high current charging pulses. As a result, gas layers on plate surfaces are broken up.

ALL-PLASTIC CONSOLES

A technique that uses injection-molded polystyrene with pressure-formed polyurethane backing for complete plastic hi-fi and TV consoles is being adopted by G.E. Called Acoustafom, the processes sonic welds cabinet parts together so they perform as a highly-damped air chamber.

(continued on page 14)
ONE TV Repair Shop in your locality... will soon stand out head and shoulders above every other competitor in town. It could be YOU.

Want to know HOW? Very simply:

by using a regular series of clever, inexpensive "column" ads in your local newspaper! You doubt it? Well...

... A TV shop in Maryland had to hire more help within 3 weeks after starting their series!

... A dealer in Montreal has had people come in from all over Canada, from his ads.

An enterprising repair man in Louisiana has acquired 4 other places in his area from the surge of business that his series brought.

Two cousins in a New England community attribute 75% of their business to these ads.

You can see their secret... adapt their methods, invest in your business... gain an immediate edge on competition... and develop a friendly, permanent clientele by judiciously using the same inexpensive idea!

Our new folio—which we'd like you to try out for six months—is called "How to Double Your Business with Unique 'Column' Ads."

It shows how others have done it... replete with case histories.

It shows how you can do it, too. It shows how and when, where and why—the whole fascinating story of this cheapest means of advertising... with most effective RESULTS! Here are ads that will attract attention—stimulate curiosity... arouse interest, amuse readers and make YOU known and remembered for quality... service... integrity... dependability.

All at trivial cost!

Among the Advantages you will learn... how to create interest among prospects who never even knew you existed!

... how to influence people to switch over to your business or service!

... how to create excitement—even though your business seems dull and drab!

... how to get the most out of your promotional dollar (something most business men never learn)!

... how to get your customers "to work" for you!

... how to get fast action from a $3 investment!

... how to keep interest sustained over an extended period!

... how to make people laugh... and agree with you... and seek to meet you personally!

... how to get maximum assistance without charge from the newspaper staff!!!

... how to develop continuing ideas!

And, above all—

A Special "TV REPAIR" PROMOTION SUPPLEMENT!

H. K. SIMON ADVERTISING
BOX 236
HASTINGS-ON-HUDSON
NEW YORK 10706

"TV REPAIR" PROMOTION SUPPLEMENT—
shows you:
... How to out-smart (instead of out-spend) the competition!
... Why most ads fail...
... The ONE BIG SECRET of successful TV Repair advertising.
... The Greatest Compliment any ad can Pay You.
... The mistake that is made by 98 out of 100 local advertisers...
... 94 examples of enticing "come on in" copy (distilled from thousands).
... 26 Merchandising Ideas that you can adapt, to stimulate business.
... 37 Illustrations that enliven the ad, attract the eye.

Here are "Big Time" ideas at "small time" prices. Prepared by a $25,000 copy group... but your cost is less than 40¢ per week!

You'll refer to this for years—every time you need copy to promote special occasions... or an idea for a layout... or an eye-caching border... or a good illustration!

You'll see how to establish your name as an outstanding source: as helpful... friendly... sincere... intelligent... courteous... dependable.

You'll see how to have people looking forward to your ads—wondering what you will say next!

You run very little risk, if you accept this opportunity—because we GUARANTEE that any one using these ideas six months or more who does NOT hear favorable comment—who does NOT see direct results at lower cost—can simply say so, and we'll REFUND 100% of every penny you paid us!

We think this offer is unique. We dare to make it only because we KNOW this will prove profitable to you.

Who in your community will benefit by this? WILL YOU? Better advise us at once.

Write or wire us TODAY. Use the handy blank below.

Suppose YOU spent 3 weeks with an advertising agency...

... developing a year's program for your business that would make you well-known—give you a competitive edge... bring customers to your door... stimulate your sales... save wasted efforts on unproductive promotion.

Personal service, of course, is expensive. The ad agency's fee would be about $2,000, plus your traveling and maintenance expenses.

But we have completed just such an intensive 3-week conference... and you may have the results for a tiny fraction of that cost!

Let me ask you... how is your present ad program going—now? Was it prepared well in advance, by a "pro"? Or do you promote your services, catch-as-catch-can, when you can spare a moment?

The difference between the two methods can mean a doubling of your annual gross.

Perhaps you've always thought, "I can't afford a high-priced ad man."

But surely, you CANNOT afford him if he costs you only 40¢ a week. And if that 40¢ weekly expense brought you $7,500 a year—would you afford to be without it?

"True," you say, "it is so good as all that."

We think it is. But we want YOU to be the judge.

Try the ideas for the next six months. Then—if you don't expect to get back at least $1,995 for your $19.95 investment (a return of 100 to 1—or better) simply send it back for full refund.

Could anything be fairer?

Since there's no obligation, why not accept? Promotion-wise, I doubt if you'll EVER get another opportunity to equal it. But...

Better act TODAY. This offer may be withdrawn when our supply of copies run out. So write or wire NOW!

H. K. SIMON, Advertising Co.
Box 236, Dept. RE-41
Hastings-on-Hudson, N. Y. 10706

Kindly send "HOW TO DOUBLE YOUR BUSINESS WITH UNIQUE 'COLUMN' ADS" along with your "TV REPAIR" PROMOTION SUPPLEMENT to:

NAME
ADDRESS
CITY, STATE
ZIP

We enclose our check for $19.95.

It is understood that if we use your ideas for six months or more and are not fully satisfied, every cent will be refunded.

REFERENCES: Any publication in the U.S.A. • Rated by Dun & Bradstreet

JANUARY 1970

Circle 11 on reader service card

www.americanradiohistory.com
ALL-CHEMICAL LASER NEEDS NO ELECTRICITY

A 1000-watt laser may require at least 20,000-watts of electrical power as an input. But now two scientific teams at opposite sides of the country have developed a laser that requires no electrical power—it's all chemical. Laser energy is released by chemical reaction, which produces coherent light much more efficiently than conventional lasers that usually run at less than 2% efficiency.

The International Journal of Chemical Kinetics, reporting the discoveries at The Aerospace Corp. and Cornell University, says that controlled atomic fusion may be possible with the huge amount of power available from large chemical lasers. In principle, power output would be limited only to size of the optical chamber and the rate at which chemicals could be fed in.

AVAILANCHE DIODES EMIT UHF WAVES IN ANOMALOUS MODE

PRINCETON, N.J.—By operating avalanche diodes in the so-called "anomalous mode," RCA scientists have achieved the most powerful uhf radio waves yet from a solid-state device. This mode occurs when the diodes are placed in a circuit tuned to oscillate at rf frequencies below the oscillation capability of the devices. When electrical pulses are then applied to the diodes, they abruptly and unexplainably begin to generate high-powered microwaves. Five diodes in a small package have produced peak powers above 1200 watts.

The discovery could revolutionize radar, says RCA, who foresee applications in powerful phased-array radars, which use thousands of individual transmitters in place of the single high-power source in conventional radars.

4-CHANNEL ENCODING PROVIDES HI-FI AND GOOD SEPARATION

Despite widespread interest by manufacturers in the new, experimental 4-channel "surround" stereo (New & Timely, December 1969), not everyone is going "all out" for four-track tape machines as a sound source.

Manufacturers may be taking a closer look at an analog encoding technique for 4-channel sound developed by engineer-inventor Peter Scheiber of Auto-data in Rochester, N.Y.

Scheiber's patent-pending process uses an encoder to put the two additional rear channels on the same record grooves, tape tracks or FM band as the front-channel stereo. An inexpensive decoder circuit in the tuner or preamp then separates the 4 channels.

Biggest advantage to the system is its compatibility. A regular stereo cartridge can be used with the decoder to obtain 4-channel sound, but anyone playing the encoded record would be unaware it differed from a regular stereo record. Similarly, the technique could put 4 channels on normal stereo cassettes, open-reel tapes or FM without affecting the stereo channels.

One observer who heard a demonstration of Scheiber's system said the process maintains good separation and fidelity on each channel.

JAPAN MOVES TO IC'S

OSAKA, JAPAN—The switch to integrated circuits was evident throughout the Japanese electronics at the 1969 electronics show. According to a report in Electronic News, IC's are being used in many TV sets, radios and stereo phonographs.

Sanken Electric Co. revealed a hybrid IC with a 120-watt output. A number of manufacturers showed varactor-tuned uhf TV tuners, and one company had a pocketable LCRV tester. Another company showed a telephone-size IC frequency counter.

Another electronics show is scheduled for April 1970 in Tokyo.
P.E.P. UP WITH P.E.P.

vacation in paradise ... free

4 DAYS & 3 NIGHTS AT FABULOUS PARADISE ISLAND
You're VIP guests of Gavin for sun, fun, surf and a royal holiday ... at Nassau's vacation paradise, Fly by luxury jet. Dine like a king. Gavin pays for everything ... from jet trips to tips.
VACATION FOR TWO ... 8 MONTHS TO JET THERE.

THIS FAMOUS SEAL PUTS P.E.P IN YOUR SALES
Now Gavin puts P.E.P in every package, with the famous Good Housekeeping Seal of Quality. Consumers buy this emblem of excellence ... adding proud new salespower to Gavin outdoor and indoor antennas ... UHF converters too!
And full color Good Housekeeping ad muscle builds extra sales for you.

Circle 13 on reader service card
FOCUS VOLTAGE IS PRETTY IMPORTANT to color TV. Poor focus makes a good picture look fuzzy, and the owner beefs about it, with reason. However, if you can see clean, sharp scanning lines all the way across the screen, don't bother with the focus voltage. That isn't the problem. The focus voltage supply only has to make the scanning lines show. Other smearing is in the video, and that sort of thing.

In all color CRT's, focus voltage should run about 4.5 kV, with 24 kV of high voltage. This should always be the same percentage of the high voltage. If the high voltage varies, the focus voltage should vary with it. The actual percentage is somewhere very near to 20%. Feeding the anode of the focus rectifier from the flyback tap connected to the horizontal output plate helps quite a bit. Variations in beam current change the loading here, and the focus voltage stays pretty well with the high voltage.

Lately, a different circuit has shown up in several sets. Since the focus voltage should be a percentage of the high voltage, why not take it off with one of the oldest circuits in electronics—a voltage divider? One reason why this wasn't used earlier was the lack of resistors that would stand up under this tremendous voltage. The basic circuit is in Fig. 1. The focus voltage is picked off at the low tap. So if high voltage changes, focus goes right along with it.

The circuit, and resistance values, used in the GE G-1 color chassis, with a 15MP22 picture tube is in Fig. 2. The dropping resistor, in this set is a three-section, plastic-encapsulated unit with three 80-megohm sections. It is mounted crosswise in the bottom of the flyback cage. For adjustment, a 20-megohm variable resistor is connected to the bottom of the big resistor. A fixed 47-megohm unit is the other part. The bottom of this section can be returned to B-boost, B+ (280 volts) or ground as needed for minor corrections.

In Motorola color chassis such as the TS-912, 914, 920, you'll find the big dropping resistor used with a 15-megohm variable for control, followed by 47 megohms and a fixed 15 megohms to ground. This final resistor may be shorted with a jumper if necessary to center the focus control slider (Fig. 3).

(continued on page 74)

THANK YOU JACK DARR

For ten years you've been delivering to the Readers of Radio-Electronics the most personalized help they can get. You answer their questions, present a monthly column crammed with vital service data and are always available for consultation on a service problem, or question. This month, as we set foot into the eleventh year of your reign, we look forward to your continued A-OK performance.

--The Editors
Voltage supply in your city can vary as much as 10%. And even a 2% variation causes a significant tape speed change in tape decks with induction motors and a difference in reproduced sound that is intolerable.

The Concord Mark II stereo tape deck completely ignores fluctuations in line voltage. It is driven by a hysteresis synchronous motor which locks onto the 60 cycle power line frequency and maintains constant speed (within 0.5%) regardless of voltage variation from 75 to 130 volts. So if you're about to buy a tape deck that doesn't have a hysteresis synchronous drive motor, you're liable to negate any other fine feature it might have.

Don't get the idea the hysteresis motor is all the Concord Mark II has to offer. It also has just about every other professional feature. Three high-quality heads: ferrite erase head; wide gap Hi-Mu laminated recording head for optimum recorded signal and signal-to-noise ratio; narrow gap Hi-Mu laminated playback head for optimum reproduced frequency response. No compromise combination heads. The three heads and four preamplifiers also make possible tape monitoring while recording.

The tape transport mechanism assures a fast startup—you don't miss a note. Supply and takeup tape tension arms eliminate startup burble. A special flutter filter eliminates flutter due to tape scrape or cogging action. A cue control provides instantaneous stop and start operation. Other important conveniences: the flip-up head cover permits you to see the head gap position markings for professional editing; 3 speeds; automatic sound-on-sound with adjustable level controls; variable echo control for reverb recording; calibrated VU meters with individual record indicator lights; stereo headphone jack; electronically controlled dynamic muting for automatic suppression of tape hiss without affecting high frequency response. All this, for under $230.

The hysteresis drive Concord Mark III has all of the features of the Mark II plus pressure-sintered ferrite heads for extended frequency response and virtually no head wear. It sells for under $260.

The hysteresis drive Mark IV, the top-of-the-line Concord deck offers all of the performance and conveniences of the Mark II and III including wide gap record, narrow gap playback heads, tape source monitoring, sound-on-sound, echo recording, plus, a dual capstan tape transport mechanism with electronic automatic reverse, no metal foil or signal required on the tape. Superior recording performance plus the convenience of automatic reverse and continuous play. A superb instrument with the finest performance money can buy, and it's under $330. Audition the new Concord Mark series, the tape decks with the hysteresis synchronous drive motor. For "all the facts" brochure, write: Concord Electronics Corp., 135 Armacost Ave., Los Angeles, Calif. 90025. (Subsidiary, Ehrenreich Photo-Optical Industries, Inc.)

For copy of Concord Mark III Instruction book, mail 25¢ to:

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EITHER AIR CONDITIONERS, TV SETS, WASHERS NOR ANY OTHER ELECTRICAL APPLIANCE CAN KEEP THE Hysteresis-Drive Concord Mark II FROM ITS PRECISELY APPOINTED SPEED.

JANUARY 1970

Circle 15 on reader service card

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www.americanradiohistory.com
In today's electronics boom the demand for men with technical education is far greater than the supply of graduate engineers. Thousands of real engineering jobs are being filled by men without engineering degrees—provided they are thoroughly trained in basic electronic theory and modern application. The pay is good, the future is bright... and the training can now be acquired at home—on your own time.

**How to become a “Non-Degree Engineer”**
niques that make learning at home easy, even if you once had trouble studying. Your instructor gives the lessons and questions you send in his undivided personal attention—it’s like being the only student in his "class." He not only grades your work, he analyzes it. And he mails back his corrections and comments the same day he gets your lessons, so you read his notations while everything is still fresh in your mind.

Students who have taken other courses often comment on how much more they learn from CIE. Says Mark E. Newland of Santa Maria, Calif.: "Of 11 different correspondence courses I've taken, CIE's was the best prepared, most interesting, and easiest to understand. I passed my 1st Class FCC exam after completing my course, and have increased my earnings by $120 a month."

Always Up-to-Date
Because of rapid developments in electronics, CIE courses are constantly being revised. This year’s courses include up-to-the-minute lessons in Microminiaturization, Laser Theory and Application, Suppressed Carrier Modulation, Single Sideband Techniques, Logical Troubleshooting, Boolean Algebra, Pulse Theory, Timebase Generators...and many more.

CIE Assures You an FCC License
The Cleveland method of training is so successful that better than 9 out of 10 CIE graduates who take the FCC exam pass it. This is despite the fact that, among non-CIE men, 2 out of every 3 who take the exam fail! That's why CIE can promise in writing to refund your tuition in full if you complete one of its FCC courses and fail to pass the licensing exam.

This Book Can Help You
Thousands who are advancing their electronics careers started by reading our famous book, "How To Succeed in Electronics." It tells of many non-degree engineering jobs and other electronics careers open to men with the proper training. And it tells which courses of study best prepare you for the work you want.
If you would like to cash in on the electronics boom, let us send you this 44-page book free.
Just fill out and mail the attached postpaid card. Or, if the card is missing, mail the coupon at right.

NEW COLLEGE-LEVEL CAREER COURSE FOR MEN WITH PRIOR EXPERIENCE IN ELECTRONICS
ELECTRONICS ENGINEERING...covers steady-state and transient network theory, solid state physics and circuitry, pulse techniques, computer logic and mathematics through calculus. A college-level course for men already working in Electronics.
NEW FOR YOU

For manufacturer's literature, circle No. 79 on Reader Service Card.

Harman-Kardon CAD-4 Stereo Tape Cassette Deck

Would you believe a cassette deck that is almost hi-fi? I didn't, until I tried this one. It's amazing! The main limitations turn out to be the quality of the precorded cassette material currently available.

We A-B'd a precorded cassette against the same company's recording of the same material on a top quality disc. The record did sound better. It had more highs and no tape hiss. (The hiss problem is a tough one to lick. You're looking at a very slow tape speed, 1 1/2 ips. With current tape, you almost can't avoid it.)

However, when we taped from the disc we found we got somewhat better fidelity from the tape we made from the record than was on the precorded tape.

Chromium dioxide tape may help this problem a bit, but don't expect it in the very near future. There are still several headaches to be solved.

Having recently received some TDK C-60SD cassettes, we gave them a trial too. The tape is claimed to have a frequency response or 30 to 20,000 Hz. But in the deck there didn't seem to be much difference between it and the cassette tapes provided. Perhaps the new tape does offer the frequency response specified, but someone is going to have to build the cassette machine that can handle this range of frequencies before we can take advantage of the tape. Now back to the review.

Conclusions were that while this deck doesn't deliver 20-20,000 Hz response, it does show that high-quality recording on cassettes is possible and is getting there. I would have little hesitation in adding a deck of this quality to my system, but I would have to remember that it does have limitations. One other interesting point. The tape bias oscillator frequency can be adjusted. This is not a front-panel control, but could make a bit of difference in frequency response if carefully matched to the tape you use.

—Joe Shane

**SPECIFICATIONS**

**Frequency Response:** ±2 db, 30-12,500 Hz.
**Harmonic Distortion:** below 1.5%.
**Wow and Flutter:** 0.25 mV rms at 1 1/2 ips.
**Tape Speed:** 1 1/2 ips.
**Tape Speed Variation:** within 2%.
**Signal-to-Noise Ratio:** better than 49 dB.
**Cross Talk:** better than 35 dB.
**Erasure:** better than 55 dB.
**Bias Oscillator Frequency:** 105 kHz ±5 kHz.
**No MX beats regardless of tuner used.**

**INPUT SENSITIVITY:**

- **High Level:** 200 mV, ±2 dB for zero VU
- **Low Level:** 0.2 mV, ±2 dB for zero VU

**INPUT IMPEDANCE:**

- **High Level:** 200,000 ohms
- **Low Level:** 2,500 ohms

**Output Level:** 0.8 V, rms, ±2 dB at maximum recording level.

**Sizes:** 12 1/2 x 9 x 3 1/4 inches

**Weight:** 10 pounds

Key component layout inside the CAD-4 stereo tape cassette deck. Note that all controls are pushbuttons intended for ease of operation. When the user depresses the TAPE EJECT the trap door over the cassette opens and the cassette pops out.
This man is absolutely ruthless!

He's got the job of seeing that Opti-Vue's meet the highest standards of color purity, clarity and brightness.

We pay him to be ruthless.

On final inspection, under actual operating conditions, he says "go" or "no go" on every Channel Master Opti-Vue that comes off the line.

His word is final. So is his quality control supervision of the 117 other tests and inspections on every Opti-Vue CRT. He's even washed the new "extra bright" rare earth phosphors down the drain because he knew a screen did not live up to Channel Master's reputation of equaling or exceeding industry quality standards.

That's why you'll find Channel Master tubes in some of 1970's finest color sets. That's why you can point with pride to the name Channel Master on a color replacement tube.

Call your Channel Master distributor. He's a good guy. He's your Picture Tube Headquarters.

At Channel Master YOUR Reputation is OUR Business.

CHANNEL MASTER®
DIVISION OF AVNET, INC., ELLENVILLE, NEW YORK 12428

Circle 19 on reader service card
ANNOUNCING
An All New MIGHTY MITE Tube Tester

Now Checks more tubes and it's faster than ever before with

- all solid state FET circuitry for instant-on action...first time in tube tester history
- New solid action push button function switches to speed up every test

Here is the latest version of the famous Sencore Mighty Mite tube tester; it's updated and streamlined in appearance and performance. No more wasted time waiting for the tube tester to warm up when you have a hot troublesome tube in your hand ready to test. The TC154 Mighty Mite VI is instant-on with no meter drift. New FET circuitry still enables you to read grid leakage up to 100 megohms because it too is a high impedance device like a vacuum tube. New circuitry permits even higher sensitivity check on heater to cathode leakage; from 180,000 ohms to 300,000 ohms. The Mighty Mite still checks for shorts between each and every tube element with the famous stethoscope shorts check. New two-toned vinyl-covered and brushed steel presents a truly professional instrument. See your Sencore distributor today and ask him for the new all solid state Mighty Mite. Only Sencore has it.

Over 60,000 Mighty Miles now in use.
Only $89.50

Sencore
No. 1 Manufacturer of Electronic Maintenance Equipment
436 South Westgate Drive, Addison, Illinois 60101

Circle 20 on reader service card

Letters to R-E

ANTI-KRENZ

Mr. Ed Krentz' positive attitude toward certification of all electronics technicians in the October, 1969, Correspondence Column, reveals a common weakness of all human beings, and that is to wrap up, sew up, and institutionalize anything that isn't nailed down.

The analogical models that Mr. Krentz utilizes to establish his case for such organization is also faulty and contains an opposing cutting edge. If our forefathers were so institutionally organized, I doubt that we would have to worry about light bulbs, radios, telephones, or for that matter the man on the moon. I doubt that the Thomas Edisons, Marconis, Alexander Graham Bells, or the Robert Goddards would have emerged within this type of organizational structure.

Mr. Krentz also appears to have a medical hangup. His medical analogical model has a limited comparison value. The cause and effect relationships between physicians, surgeons, and their patients are more direct and the consequence far greater. Mandatory membership in medical organizations can at least be understood for the purpose of policing and establishing a level of competence for the protection of human lives. This circumstance, while true for the medical profession, is not true for the electronics technician. If life is endangered by electronics, it is most often the fault of poor design and manufacturing, or faulty use of equipment, and there is an established legal recourse for this type of problem.

Mr. Krentz' basic premise of forced organizational membership can be applied to all facets of our lives, then finally we will need a master coordinating and directive organizational structure to handle all the subunits in to the final complete total corporate structure—'The Ant Hill.'

ALBERT BASCO
5355 N. Luna Ave.
Chicago, Ill.

COLOR ORGAN CORRECTION

Although the author's original main telephone was correct (Fig. 2, "Stereo Color Organ," October 1969), our artists got carried away and drew an extra line. Delete the line from the cathode end of D22 (lower right) tying it to ground. Our thanks to Mr. Ray O. Couvillon of Houston, Texas, for pointing out the error.

R-E
Our hot ones are the last to go.

The last thing you need is to be called back a day or two after you've replaced the sweep or high voltage tubes in somebody's color TV. But, they're usually the first to go. Because they get so hot. So we figured out how to cool them. Now, they last a lot longer. Take our 6JE6C/6LQ6, for example. It's the horizontal deflection tube that takes such a beating when the set gets hot.

Well, we've given it special patented radiator fins that first absorb the heat and then radiate it out of the tube. Now it runs cooler and lasts longer. Same for our 6JS6C. Or take our 6BK4C/6EL4A. That's the shunt regulator that eliminates runaway high voltage. We gave this one a whole new anode and shield design to improve heat transfer and stability. Now it also runs cooler and lasts longer.

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Circle 21 on reader service card

January 1970
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Circle 22 on reader service card
COLOR TV 1970: IT'S THE YEAR OF "BLACK SURROUND," "black honeycomb," europium-activated gadolinium and yttrium oxides, super-bright tubes and, not to be forgotten, the Trinitron. The color picture tube brightness war started in earnest six years ago when Sylvania introduced europium-activated red phosphors, claiming a 40% brightness increase. It's been escalating—to everyone's benefit—ever since.

RCA fired the first barrage for 1970 early. In midsummer last year they announced their 100% brighter Hi-Lite Matrix tube, featuring an opaque black masking surrounding each of its 1.2 million phosphor dots. Zenith, who had been working on a similar—but not identical—"black surround" principle since 1960, quickly brought its Chromacolor tube to the front line. Most picture tube manufacturers—G.E., Westinghouse, Motorola, Admiral, Sylvania—then rolled out "super-bright" tubes, some utilizing only new phosphors and others the new black surround.

Soaking up ambient light

Let's see what black surround tubes like Zenith's Chromacolor can do. If you've ever tried to watch color TV with bright sunlight streaming into the room, you know how poor the picture becomes. The image that reaches your eyes is "washed out."

Sunlight passes through the tinted glass on the front of the picture tube, bounces off the phosphor-coated viewing surface and heads toward you after again passing through the tinted glass. Picture contrast is sharply decreased since you're also viewing the phosphor-coated CRT surface illuminated by ambient light. Since external light must pass through the filter glass twice, manufacturers carefully balance filter density (transmissivity) against the brightness available from the red, blue and green phosphor triads for the best contrast and brightness.

Now Zenith and others have developed a technique for surrounding each phosphor dot with an opaque, jet-black material. About 50% of the screen area is covered with the material. By definition, this "black surround" does not reflect ambient light falling on it. Because external light is absorbed instead of reflected, there's no need for high-density, picture-dimming filters.

Zenith's switch to 80% transmission glass for Chromacolor from 42% in their conventional tubes is illustrated in the photos. With improved phosphors, this boosts brightness more than 100% over their conventional tubes and provides 25% more contrast.

And there's another advantage to the black-surround approach. In conventional tubes the entire screen area is coated with phosphor materials. Large numbers of stray electrons strike this "white surround" and reduce image detail. The black surround is unaffected by stray electrons; back reflected light from the tube's front surface is similarly neutralized.

The shadow-mask, electron-beam, triad arrangement for regular color tubes is shown in Fig. 1-a. The dots in each triad are tangent to one another, and the electron beam, its diameter fixed by the mask aperture, excites most of the dot area but leaves a circular guard band. This tolerance band is necessary for good white field color purity.
But in the Chromacolor tube (Fig. 1-b) the electron beam is wider than the phosphor dots, and the guard band spills onto the black surround without affecting the picture.

To accomplish this, Zenith starts with a shadow mask that has smaller apertures than standard masks. The mask is used to screen 1.35 million phosphor dots on the surface of the picture tube. Then the mask holes are enlarged to permit electron beams wider than the dots to pass through.

This electron beam “spillover” on the dots is useful. Now, instead of holding back the efficiency of some phosphors to keep beam currents equal, the dot diameters can be varied according to phosphor efficiency. Using some of the brightest phosphors available, Zenith deposits 0.12-inch red, 0.13-inch green and 0.12-inch blue dots. The dots and aperture holes in the mask are graded in diameter toward the edge of the screen.

Both RCA and Zenith are using new, higher-resolution electron guns in their black surround tubes. Zenith says the spot size in the Chromacolor is 25% better than earlier tubes, providing a sharper, clearer picture.

Admiral has developed a super-bright picture tube using what they call a “black honeycomb,” and Westinghouse also has a black-surround tube. Neither manufacturer has released details.

Sylvania, who had a very bright tube going into the 1970 competition, decided not to go “super bright.” Instead, they’ve improved their phosphors to boost brightness one-third, and claim 30% more contrast with a “sharper” picture. General Electric switched to a europium-activated gadolinium oxide in their ‘70 tubes, saying the new red phosphor is 20-70% brighter than those in use.

Improving rare-earth phosphors

Researchers have known for some time that rare-earth phosphors radiate light more efficiently. But the scarcity of rare-earth metals makes them expensive to produce commercially. G.E.’s new gadolinium oxide, for example, costs more than $150 a pound.

A glance at Fig. 2 shows why manufacturers are willing to pay 10-15 times the price of sulfide-type phosphors for rare earths. The high peaked curve represents light emitted from europium-activated yttrium orthovanadate, introduced as a red phosphor in 1964. The smaller, wider curve is that of silver-activated zinc cadmium sulfide, widely used as a red phosphor before the rare earths became commercially available.

Although the sulfide curve peaks more into the red (longer) wavelengths, the vanadate appears redder to the eye. Much of the sulfide curve is in the shorter wavelengths, and the eye sees a more “orangish” red. The vanadate phosphor appears brighter because most of the sulfide emission is in a region where the eye is least sensitive. (A curve indicating eye sensitivity would peak at 550 nanometers, the green portion of the spectrum.)

If you’ve made the change from sulfide-phosphor tubes to those with rare earths, you may be aware of another improvement. Red rare-earth phosphors are a white powder, while the sulfide type has a yellow-orange body color. When ambient room light falls on the rare-earth dots the light is reflected and only slightly dilutes the red hue. The sulfide phosphor, however, reflects yellow light that mixes with the red emission and shifts it toward orange-yellow. Consequently, early sets lost much of their red when viewed in ambient light.

Can you see more colors with the newest phosphors? The current debate is over which phosphors offer the best combination of hue and brightness. The europium-activated red phosphors generally peak at about 612 nm. What takes place when this wavelength is varied from one red phosphor to another can be seen in Fig. 3.

This is a standard color coordinate diagram, adopted in 1931 by the International Commission on Illumination.
The wavelengths of the pure spectral colors are specified in nanometers along the curved periphery. Using the proper x-y coordinates, various proportions of two or more colors can be combined by additive mixing to denote other colors.

For example, the coordinates of a Stehman Apple are: \( x, 0.514 \) and \( y, 0.330 \). The coordinates for a Best Times Rose are: \( x, 0.589 \) and \( y, 0.245 \). Most of the reflection colors that occur in nature and all known dyes and printing inks lie within the dot-dash contour.

Triangle \( abc \) is formed by the coordinates for the phosphors used for color picture tubes before the rare earths were introduced. With the proper currents to the red, green and blue CRT guns, all the colors enclosed in the triangle can be generated with a triad, as well as pure white at point \( F \).

**Eye sensitive to red changes**

The color coordinates for yttrium vanadate indicate it appears as a pure spectral red to the eye, at 612 nm on the diagram. You can see that triangle \( abc \) for the vanadate encloses a wider range of color. Although the change is very small with the vanadate phosphor, the color changes occur in an area of the spectrum where the eye is quite sensitive to color differences. Thus the change from sulfide-type to rare-earth red phosphors brought a significant increase in the range of reds as well as more brightness for the newer tubes.

Another disadvantage of sulfide-type phosphors is their tendency to saturate with higher beam currents. For highlight areas on the screen, there is a shift toward the orange portion of the spectrum and the light output of the phosphor decreases. This causes whites to shift to green or blue when highlights are on the screen. Triangle \( abd \) shows the effect of saturation on the color triangle.

Not represented on the diagram are changes in brightness that occur with various phosphors. Colors—except for small changes in hue with red phosphors—have been standardized, and manufacturers are now trying to obtain the brightest rare-earth chemical combinations for their super-bright tubes.

**Sony's Trinitron**

Until the super brights this year, American-made shadow-mask color tubes had at least one disadvantage in comparison with Japan's Trinitron tube. The shadow mask held back electrons reaching the phosphors, unlike the single-gun, aperture-grille construction of the Trinitron (Fig. 4).

Sales of 12-inch portable Trinitron sets are booming in this country. Sony reportedly plans to introduce a larger-screen version—perhaps this year.

The Trinitron utilizes a single electron gun and three in-line cathodes to direct an electron beam through the aperture grille onto separate red, green and blue phosphors stripes. Sony also likes to point out that their large, single electron lens is able to focus a sharper image than the three smaller lenses in shadow-mask tubes.

Which type of tube provides the best picture? There's only one way to really tell since color pictures are somewhat subjective: Visit today's sunlit showrooms and see them yourself.

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<td>Add Automatic Tint Control</td>
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<td>Build R-E's Dot-Bar Generator</td>
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<td>Service Clinic</td>
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ADD TO YOUR COLOR TV
AUTOMATIC COLOR

by STEVE LECKERTS

THIS YEAR COLOR TV SET MANUFACTURERS came up with a badly needed circuit—an automatic tint control. Now, we're going to show you how to add this circuit—the only one of its kind—to your own set.

First a little history. The circuit was developed by Magnavox and is used in their T940 color TV chassis. What we are doing here is presenting it as an add-on circuit for your set.

You will find complete data on how to determine if this circuit will operate in your set and how to fit it into the existing circuitry. If you come up with questions please write the author, in care of RADIO-ELECTRONICS. Do not write to Magnavox, they will be unable to assist you as they have not done any research into adding their circuit to sets made by other manufacturers.

How it works

The circuit is intended to minimize the error in fleshtones which often occurs when you change stations or when program material changes. The problem is basically caused by the difference in phase relationship of the chroma and burst signals between stations and may even happen when a station switches cameras, or to tape, or to film.

The Magnavox circuit senses phase errors in the chroma signal that occur around the fleshtone segment of the color spectrum and add whatever correction is required to the chroma signal to provide proper fleshtones on the screen of the color receiver.

The red gate and yellow gate transistors (Q3 and Qy in the diagram) develop the needed correction. These two transistors sample the chroma information that is fed to their bases. Each gate is sensitive only to the chroma phases on either side of the proper fleshtone phase. A transistor switch completes the emitter circuit of each gate.

The combined correction signal from both gates is added to the original chroma signal by the chroma amplifier transistor. This stage is emitter driven by the same information that is applied to the gates. The base bias of the chroma amplifier is developed by the individual phase shift network in the collector circuit of each gate. These networks add the phase cor-

Foil side of circuit board. Use this pattern to make your board if you want to try adding circuit to your set.

For parts layout follow this diagram. To see where to connect the lettered terminals refer to the schematic on the facing page.
Total Automatic Color circuit to your set

A correction needed to cause the output from the RED GATE to develop a correction toward yellow, and the YELLOW GATE to develop a correction toward red. Thus the combined output of both gates mixes with the chroma signal being fed to the emitter of the chroma amplifier to produce a resultant at the chroma amplifier collector having the proper phase to produce good flesh tones on the screen.

Since chroma phases that don't produce red through yellow are negative going during the time that 3.58-MHz switch is on, the gates affect only flesh tones and are not sensitive to or affect any other portion of the color spectrum.

A correction converts all scene colors between yellowish orange and bright red to normal flesh tones.

**PARTS LIST**

All Resistors 1/2-watt 10% unless noted

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All capacitors ceramic, 500 V, 20% unless noted

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<td>20 pF, NPO</td>
</tr>
<tr>
<td>C49</td>
<td>20 pF, NPO</td>
</tr>
<tr>
<td>C50</td>
<td>20 pF, NPO</td>
</tr>
<tr>
<td>C51</td>
<td>20 pF, NPO</td>
</tr>
<tr>
<td>C52</td>
<td>20 pF, NPO</td>
</tr>
<tr>
<td>C53</td>
<td>20 pF, NPO</td>
</tr>
<tr>
<td>C54</td>
<td>20 pF, NPO</td>
</tr>
<tr>
<td>C55</td>
<td>20 pF, NPO</td>
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**Coils**

<table>
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<tr>
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<th>Value</th>
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</thead>
<tbody>
<tr>
<td>L1</td>
<td>12.35 µH peaking coil</td>
</tr>
<tr>
<td>L2</td>
<td>56 µH peaking coil</td>
</tr>
<tr>
<td>L3</td>
<td>120 µH peaking coil</td>
</tr>
<tr>
<td>L4</td>
<td>27 µH peaking coil</td>
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<tr>
<td>L5</td>
<td>6.8 µH choke</td>
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**Semiconductors**

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<tr>
<th>Part</th>
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</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>2N1711 or EN1711</td>
</tr>
<tr>
<td>D2</td>
<td>2N4916</td>
</tr>
<tr>
<td>Q1</td>
<td>2N914 or EN914</td>
</tr>
<tr>
<td>Q2</td>
<td>2N5134</td>
</tr>
</tbody>
</table>

**Here's the circuit of the Automatic Color Tint control.** Note that the semiconductors marked "**" are identified in the parts list. The circuit is comparatively simple, and easy to duplicate.

---

**JANUARY 1970**
The circuit can be installed with relative ease in both automatic-phase-control and injection-lock-type color receivers.

Four connections must be made to the receiver. They are:
1) The oscillator output to the preference phase shift network through J.
2) Chroma signal from the receiver to the automatic tint control via A.
3) Output (C) from the chroma amplifier of the tint circuit to the receiver's color demodulator.
4) Power supply for the automatic tint control to D.

Let's begin by looking at what is involved to connect the automatic tint control circuit to a color set with a two tube color demodulator driven by the 3.58-MHz oscillator. These demodulators all require between 3 and 5 volts peak-to-peak oscillator drive. This level is conveniently available at the oscillator transformer and is exactly the range of voltage required to drive Q5 in the automatic tint control circuit, after filtering (phase shifting) of the preference network. In this circuit, the 3.58-MHz oscillator transformer terminal is bridged (simply tied to) to the input capacitor of the preference network C11. This preference network must insert the proper phase shift with respect to the chroma signal to assure proper circuit operation. The relative oscillator angle is determined by the phase lock system whether it be APC or injection. For most receivers this angle will be correct as for the examples given here.

However, if because of some receiver peculiarity, insertion of the tint control circuit results in obviously wrong flesh tones, the preference circuit can be easily modified. First, moderate changes in phase shift can be introduced by changing the LC component values. Second, the high-pass network can be made into a low-pass by interchanging the inductive and capacitive tuning elements (C12 and L5). By a combination of these two techniques a full 360-degree phase angle can be covered and every conceivable oscillator phase dealt with.

Next, the chroma amplifier on the automatic tint board must be inserted in series with the receiver's bandpass amplifier. Since the tint circuit is emitter fed it presents a low input impedance to the receiver. The most convenient place to make this connection is at the set's chroma control since a 500-ohm pot is almost universally used for this application.

In the circuit we are describing, there is approximately a 5-volt peak-to-peak signal at this point as it follows the bandpass amplifier. The wiper of the chroma control is disconnected and the wiper itself connected to point AA on the automatic tint control board.

The receiver's demodulator is fed from the output of the tint circuit point C. This point is connected to the color demodulator at the point where the wiper was disconnected.

The only other concern is the power supply, which is the most difficult part of the installation since it requires some calculations to make this connection without affecting the receiver's normal supply voltages. The automatic tint control draws about 20 mA and is regulated by a 20-volt Zener diode.

A dropping resistor from a higher-voltage supply designed for between 25 and 30 mA will assure reasonable current in the Zener diode, to be safely over the Zener knee and to keep the Zener dissipation below 250 milliwatts. The receiver associated with the circuit we have been describing is line operated and has a 280-volt voltage doubler supply. The 280-volts is dropped to 140-volts through a 3,900-ohm 10-watt wire-wound resistor. It is this 140-volt supply that we will drop to 20 volts. However, we will also have to parallel the set's 3,900-ohm resistor with another resistor to prevent the 140-volt supply being lowered by the additional loading of the tint circuit.

First we compute the value of the resistor to be connected between the receiver's 140-volt supply and point D of the automatic tint circuit. This resistor must drop 140 volts to 20 volts with a current of 27 mA.

\[
R_1 = \frac{(140 - 20)}{0.027} = 4,440 \text{ ohms}
\]

There is a 10-watt power resistor available at 4500 ohms (IRC PW-5). Using this resistor the actual current will be:

\[
I = 120/4.5K = 26.7 \text{ mA}
\]
and the power dissipated in \(R_1\):

\[
P = V^2/R = (120)^2/4500 = 3.2 \text{ watts}
\]

Next we compute the current in the receiver's dropping resistor.

\[
I = \frac{(280 - 140)}{3.9K} = 35.9 \text{ mA}
\]

The current actually drawn is 35.9 + 26.7 = 62.6 mA. While it may appear that we are greatly increasing the current drain from the receiver's supply components, it should be realized that this current is only part of the current of the 270-volt supply and so is a considerably lower percentage of the supply current than first imagined. The value of resistance needed to drop 280 volts to 140 volts with 62.6 mA of current is:

\[
R_2 = \frac{(280 - 140)}{0.0626} = 2,236 \text{ ohms}
\]

Since the receiver already has a 3,900-ohm resistor performing this function we must determine what resistor should be paralleled with 3,900 ohms to give 2,236 ohms. The parallel resistance of two resistors is equal to the product of the two resistors over their sum and we can make the required calculation as follows:

\[
R = \frac{R_1 R_2}{R_1 + R_2}
\]

where \(R_1\) is the resistor we are looking for and \(R_2\) is the resistor in the set.

By some algebraic shuffling . . .

\[
R = \frac{3.9 \times 2.24/(3.9 - 2.24)}{5,140} = 5,140 \text{ ohms picking a 10-watt 5,000-ohm resistor, we check the power dissipation:}
\]

\[
P = V^2/R = (280 - 140)^2/5000 = 3.92 \text{ watts}
\]

One other point is of interest concerning the chroma levels. In some sets the chroma control is located between the first and second bandpass amplifiers. The peak to peak chroma level is approximately 100 mV at this point. However, since we are breaking the circuit and reinserting the signal with slight amplification, and since we are able to adjust signal level with the control, the insertion of the tint circuit chroma amplifier at this point is functionally correct. We still retain the convenience of connecting to the low impedance chroma control in this way.

**TEST ADAPTER COLOR TIP**

Tube-socket test adapters can be used with a scope and color generator to signal trace faulty color receivers without pulling the heavy chassis. Simply take out the tube in a particular stage that you wish to signal trace and insert the test adapter in its place, then insert the tube in the test adapter. There are numbered metal tabs that project out around the upper part of the test adapter to permit signal tracing or signal injection tests.

You will have to obtain 7- and 9-pin miniature and octal-base test adapters to cover the field of most tubes that are used in color receivers. —Robert Appel
IN THESE DAYS OF MINIATURIZATION, everything from automobiles to women's bathing suits seem to be growing smaller. But, who would have thought that miniaturization could be applied to the IC? Well, evidently someone at Motorola Semiconductor Products did. They have just announced (at a Linear IC Seminar, in Garden City, N.Y.) a couple of micro-mini DIP (dual-in-line package) IC's that are only about one fourth the size of the 16-lead DIP and have only four leads.

Designed as a 250-mW audio amplifier, the MFC4000 reduces the component count by two transistors and two transformers when used as the audio power amplifier in portable radios, tape players and phonographs.

Current drain is exceptionally low. When operating from a 9-volt source, the current ranges from 3.5 mA (standby) to 60 mA at 250 mW output. Total harmonic distortion (THD) is less than 1% up to 75 mW and rises to about 4% at rated output. With a 6-volt supply, total harmonic distortion is around 2.2% from 3 to 10 mW, 4% at 50 mW and to 8% at 100 mW output.

The other micro-mini IC is the MFC4010, a wide-band high-gain amplifier for AM i.f. and low-level audio applications. It has a minimum gain of 60 dB and low output noise (1.0 mV rms typical). These characteristics make the MFC4010 an excellent performer as a 455-KHz i.f. amplifier and as a mike preamplifier in cassette and portable recorders.

Frequency response is flat from 800 Hz to 500 KHz and is down 3 dB at 300 Hz and 1.1 MHz. Voltage gain is 68 dB with a 6-volt supply and about 75 dB with 9-12-volt supplies.

Current drain rises linearly from 3 mA at 6 volts to 9 mA at 18 volts. Typical circuit applications and data follow.—Robert F. Scott

MFC4010 Specifications
Power supply voltage: 18 Vdc max
Power dissipation (free air): 0.5 W
Power dissipation (derated above 25°C): 5.0 mW/°C
Operating temperature range: -10 to +75°C
Voltage gain (at 1 kHz): 60 dB min
70 dB typical
Output noise voltage (bandwidth 20 Hz to 20 kHz): 1 mV rms

MFC4000 Specifications
Supply voltage (V+): 12 Vdc max
Power dissipation
(soldered to circuit board and held in free air): 1.0W
Power dissipation (derated above 25°C): 10mW/°C
Operating temperature range: -10 to +75°C
Zero-signal current drain (V+ = 9 Vdc, Rl = 16 ohms): 2.5 mA typical, 6.0 mA max
Sensitivity (Pin = 50 mW r.m.s.): 15 mV r.m.s.
Power output (THD less than 10%): 250 mW min, 350 mW typical
THD (Pin = 50 mW): 0.7% typical
(Pin = 50 mW, V = 6 Vdc): 4.5%
NEW! Color TV Circuits

There's an ac line regulator, a snap-in module for color amplifier and demodulator, a new composite video amplifier and noise immune sync circuits in the 1970 sets.

By ROBERT L. GOODMAN

EXPANDED AND INNOVATIVE USE OF solid-state circuits again highlight the new color receivers introduced for 1970. The availability and lower costs of transistors and other semiconductors are being put to good use by most manufacturers to improve picture quality in their 1970 sets. Here's a few of the circuits you'll be dealing with.

Quasar ac-line regulator

The regulated 105-volt ac power supply in Motorola's Quasar sets prolongs component and picture-tube life while giving viewers a stable, clearer picture. The regulator delivers a constant CRT filament and B+ voltage regardless of line variations. As shown in Fig. 1, the power transformer and two 50-watt resistors are in series across the ac line.

A high ac-line condition is sensed by the regulator panel, which switches the two 50-watt resistors in series to dissipate the additional line voltage. This maintains 105 volts ac to the power transformer primary. With ac line voltage at 105 volts, the regulator senses a low-voltage condition and electronically shorts out the 50-watt resistors, thus holding 105 volts on the transformer primary.

The voltage regulator, therefore, can provide a voltage drop between the input and the regulated output, following Kirchhoff's law for a series circuit: the sum of the circuit voltage drops is equal to the applied voltage.

Regulator operation for high ac-line voltage occurs when the unfiltered B+ to regulator control R5 rises (Fig. 2). Transistor Q1 reduces conduction and C3 now takes longer to charge (compared to a low B+ condition). When C3's charge reaches 28 volts, diac D3 fires, gating on triac TR1, which shorts out R15 and R16. The triac remains on until the ac across its main terminals goes to zero. When this occurs, the cycle repeats itself.

Because TR1 fires late, its duty cycle is short and resistors R15 and R16 are in the circuit longer during each alternation. This counteracts the original rise in ac line voltage. Then Q2 is pulsed on at the beginning of each ac alternation to establish a zero reference. For low line voltage, this sequence is followed with the converse of the steps italicized above.

As described, the B+ is used as a "sensor" for the triac switching operation. When line voltage increases or decreases, the unfiltered B+ is used to control an RC timing circuit consisting of C3 and transistor Q1 used as a variable resistor. The unfiltered B+ is connected to its base. The conductivity (resistance) of Q1 determines how long C3 takes to charge to 26 volts and close the switch. The emitter is held at 36 volts by Zener diode D2 when the B+ goes up. This reduces Q1's forward bias and lowers the charging current. When B+ goes down, the base becomes less positive and increases the forward bias, resulting in more current. When C3 charges to 26 volts, diac D3 conducts and discharges through the pulse transformer. This current produces a secondary pulse that turns on the triac.

Here's why synchronized firing of the triac is needed. If line conditions are such that the timer requires 100° to reach 26 volts and fire the triac,
the timer starts again and reaches a second firing point at 200° (see Fig. 3-a).

During the second alternation the triac turns on at 200°, 20° into the second alternation. However, the following firings are haphazard and will produce unbalanced primary currents and pop the circuit breaker. Some type of sync is needed.

At the start of each ac alternation the timer must be restarted to turn on the triac at the same point in every cycle. The timer can be restarted by discharging C3. Hence at 0°, 180°, 360°, etc., the capacitor must be discharged. (see Fig. 3-b).

With npn transistor Q2 across C3, the base must go positive at 0°, 180°, 360°, etc., to drive the transistor into conduction and discharge the capacitor. At all other times the base is negative and Q2 is nonconductive. Full-wave rectification is used to develop a negative output waveform to cause Q2 to conduct. However, this negative waveform is coupled through a capacitor to the base of Q2. A positive pulse then occurs at 0°, 180°, and 360°.

Zenith's Dura-module

A snap-in, solid-state Dura-Module used in Zenith's 1449c51 color TV chassis contains the color amplifier and a demodulator IC.

The module circuitry is shown within the dashed line in Fig. 4. Connections to the module (U6, T5, A5, etc.) correspond to the vertical and horizontal letter and number columns printed on the module. This identification technique permits quick locations from the schematic to a point on the module and vice versa.

The heavy lines in Fig. 4 show the signal path from the first color amplifier to the IC demodulator. This color signal enters at A5, is amplified by second color amplifier Q701 and exits to the color commander control and chroma level controls through connection A7. The color commander control is an additional color level control ganged with the contrast control that varies both color and contrast level. The main color level control (in series with the color level section of the color commander) is adjusted for the proper amount

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Fig. 4

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JANUARY 1970

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of color signal required for proper tracking with contrast. Once the color level is set, the color COMMANDER control is adjusted for contrast and color level during color programs and contrast during b-w programs.

The color signal re-enters the module at B10 and couples to the demodulator. Following demodulation in the IC, color difference signals exit the module at U6, T3, and T7 to the video output amplifiers.

**Video (Y) amplifier**

The Zenith 12A12C52 chassis now uses three transistor stages to process the composite video (Y) signals (Fig. 5). Composite video is coupled through a 4.5-MHz trap to the base of the first video amplifier Q201, an emitter follower.

The composite video (Y) signal is further coupled through a 50-µF nonpolarized capacitor (shunted by a 5.6K resistor) to the base of second video amplifier Q203. Decoupling between the first and second video amplifiers is accomplished by the 4.7K and 5.6K resistors. Capacitor C206 (shunted by a 10K resistor) and the 5.6K resistor (arm of the contrast control) provide proper black-level tracking with adjustment of the color COMMANDER (contrast) control.

Thermistor R205 with a 1K resistor provides brightness stability during the first few minutes of receiver warmup. This stability is desirable since the color amplifiers require a few minutes to stabilize at operating temperature.

Composite video information (positive-going) is also coupled from the collector of Q203 through peaking coils L204 and L206 and delay line L205 to base of Q204, the third video amplifier (emitter follower). The composite video emitter output is injected into the emitter circuits of the three color video output amplifiers. Transistor Q204 is actually the emitter ground-return circuit of these three amplifiers.

Because all video amplifier stages are direct- or dc-coupled, any failure in the first video stage will be directly reflected into the cathode of the CRT. If one stage opens, the screen will be dark. And if a stage became shorted, the screen would be very bright and you may lose brightness control action.

The purpose of the phase-splitter stage shown in Fig. 6 is to change and control the phase of the chroma signal (provide proper color hue for the set viewer).

Chroma information is fed to Q103 through color control R110, and the output is tapped from both the collector and emitter. This information is applied to a phase-shifting network (R123 and C118).

This phase-shifting action can be seen in Figs. 7a, b, c, where the collector and emitter signal voltages are represented by generators delivering to the network voltages of equal amplitude but opposite phase. In Fig. 7a emitter voltage Vc is in phase with the input signal voltage; collector voltage Vc is 180° out of phase with the input signal voltage (thus 180° out of phase with the emitter signal voltage).

The emitter signal is shifted 90° by capacitor C, therefore, the emitter signal at point A appears 90° out of phase with both Vc and Vc. This 90° voltage shift is represented by Vc (Vc) and (Vc). Of course, a certain amount of the in-phase collector signal (Vc) is added to Vc at point A. This amount is determined by the adjustment of tint control R.

(continued on page 87)
Matching Resistors to Close Tolerances

by E. D. Clark

In many circuit applications, two or more resistors must be closely matched while the actual value used may be 10% or more off the specified value. Matched pairs of resistors are made but are often difficult to obtain. Here is a simple circuit I have used to match ordinary resistors to well within 1% tolerance.

Fig. 1 shows a simple bridge consisting of R1, R2, R3 and R4. Resistors R3 and R4 can be interchanged (by S2) so current unbalance can be compared. Switch S2 may consist of a toggle, knife or momentary d.p.d.t. switch. S1 may be a toggle or normally closed push-button switch. The meter is an old 0-2-mA, 50-ohm movement in a vorn. Any similar meter is suitable. The meter (M) is connected (as shown in dashed lines) across points X-X when checking resistors up to 100 ohms or so.

The dc amplifier in Fig. 2 is used when matching resistors up to 500,000 ohms. The transistor is in a common-emitter circuit with R7 limiting current through the meter. Resistors R6 and R8, in conjunction with the resistors being checked, form a voltage divider that provides base bias for the transistor. The amplifier is connected across the bridge at X-X. The 4.5-volt battery in the bridge supply is suitable for resistors up to at least 10,000 ohms. With a 150-volt supply, resistors up to around 500,000 ohms can be compared.

The theory of operation is that when R3 equals R4, throwing R2 from one position to the other does not change the meter deflection. Also, when R1 equals R2, the meter will not deflect when used direct and will not deflect from the reference point when the amplifier is used.

Using the bridge

Connect up R1, R2, R3 and R4 (100 ohms, 10%, for example). Set R5 for maximum resistance and connect the battery and meter. If the meter reads upscale, reverse the position of S2. If the deflection is still upscale, leave S2 in the position for maximum upscale reading. (It is advisable to open S1 before operating S2. The reason is that if the S2 contacts do not break or make at exactly the same instant, a current surge of considerably higher than full scale flows through the meter.)

If the meter deflects upscale in one position of S2 and backwards in the other, note the upscale reading and then reverse the battery or meter polarity and take another reading. Leave everything in the position that gives the greatest deflection.

Now, temporarily connect a much higher resistor across R3 and then R4 and note the change in meter reading. The resistor that causes an increase in reading is the lower one and is the one to be modified to raise its value to match the other.

Remove a part of the resistor body by grinding or filing. Note the decrease in meter reading as material is removed. Check frequently for balance by operating S2. When throwing S2 causes no change in meter reading, R3 and R4 are matched.

If you want to match R1 and R2, locate the lower value as explained above and modify it until the meter reads zero. If all four resistors are to be matched, interchange R1 and R3 or R2 and R4 and repeat the procedure.

The basic bridge is quite sensitive. For example, three 100-ohm resistors and one 99-ohm resistor will show a meter reading of around 75 uA—about 3 1/2 divisions on the 1-mA scale. As a test, I used the bridge described here to match pairs of 100-, 1,000-, and 10,000-ohm resistors. When checked on a precision resistance bridge, the 100-ohm pair checked out as 107.5 and 107.6 ohms; the 1K pair measured 1,118 and 1,119 ohms and the 10K pair came in at 11,124 and 11,126 ohms.

When using the amplifier, connect the meter as in Fig. 2. With S1 open, adjust R8 for a center-scale reading. (When checking high-value resistors, it may be necessary to increase the value of R6 before the meter can be centered. Now, proceed to match the resistors as described earlier. When matching is fairly close, R5 can be adjusted to apply full voltage to the bridge resistors.

An easy way to handle R1, R2 R3 and R4 is to mount them in a Jones-type barrier terminal strip.

Modifying Resistors

There is nothing new about changing the value of composition resistors such as Ohmite Little Devils but I’ve found that grading part of the resistor body away seems to work better than filing or scraping as the latter methods seems to cause erratic changes in resistance. I leave the resistor being modified in the test circuit and watch the meter as I grind away the material.

One word of caution: Heat generated by grinding will cause a temporary additional increase in resistance. So, when nearing the desired value, let the resistor cool to ambient temperature before rechecking. This method allows the matching of three other resistors to one with a higher value. The latter may be a 1% precision unit if desired. Seal out dirt and moisture with a coating of service cement or epoxy cement.

Matching by Selection

It may surprise you to know that you can sometimes get two or three 1% pairs from a random group of ten resistors of the same value and make. When matching by selection, the resistors being compared are within 1% if balance can be obtained by shunting either one with a resistor 100 times its value. While ordinary carbon resistors do not have the stability and low-noise characteristics of deposited-carbon and metal-film types, they are useful in such applications as split-load phase splitters and grid resistors in push-pull amplifiers.

Two resistors may also be matched by using the larger with an additional resistor that will bring its value down to the level of the smaller one.

Jan 1970
**COLOR TV 1970 | BUILD R-E's IC color pattern generator**

With IC's you can make a really special color pattern generator. The only front panel control is the pattern selector switch.

By RAYMOND G. KOSTANTY

**WHAT FEATURES DO YOU LOOK FOR IN A COLOR BAR-PATTERN GENERATOR?**

Outstanding stability, ease of operation, a variety of patterns, generous use of the most modern semiconductors and integrated circuits, instant warmup, low cost, compactness and light weight? If so, this generator, which has all these features, is for you.

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**Circuit operation**

The pattern generator is dependent upon three basic building blocks: the inverter, the nor gate and the J-K flip-flop.

The simplest element is the inverter. Its symbol and truth table are in Fig. 1-a.

In digital circuits, the signals into and out of an element are classified as high or low. In the truth tables, high is represented by the symbol 1 (one) and low is represented by 0 (zero). With the IC's used in this pattern generator, any voltage into or out of the basic elements greater than +0.70 volts is defined as a 1, and any voltage less than this is defined as 0.

Returning to the truth table in Fig. 1-a, we find that a 0 appears on the output of an inverter when its input is 1 and vice versa.

The operation of the nor gates is explained in Fig. 1-b. If either or both inputs are 1, the output is 0.

The small circle at the output of the symbol can be thought of as meaning an inversion. Thus, a nor gate is an or gate followed by an inversion.

When an and or or function is needed, it can be produced as shown in Figs. 1-c and 1-d.

The J-K is the most versatile flip-flop available and is widely used in frequency dividers, counters and shift registers. Its symbol is in Fig. 2.

It has three inputs—J, K and C, (frequently referred to as S, C and T, respectively), and two outputs—Q and Q (frequently referred to as the 1 and 0 outputs, respectively).

The J-K flip-flop is a clocked device; that is, the outputs change only after a negative-going signal (clock) is applied to its C input. The state of the outputs after the clock pulse is determined by the state of the inputs and outputs just prior to the clock pulse.

For example, if J is 0 and K is 1 before the pulse, then Q is 0 and Q is 1 after the clock pulse has arrived. (The Q output is always opposite the Q output.)

If both the J and
Everything but the selector switch goes on this circuit board. The top diagram is the foil side of the board. The bottom diagram is the components side. Wiring and components in color are mounted on the foil side of the board. Interior of the completed unit is shown at the left.
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K inputs are 0, every time a clock is applied, the outputs change (toggle). If the clock signal is a square wave, the output is a square wave of half the clock frequency, since the flip-flop can change state only just after the clock has gone from 1 to 0.

The outputs can be made to memorize their last states or prevented from changing by making both J and K high.

A fourth input, the direct clear, Cx, when high will force the O output to be 0 regardless of the J, K or C states. It is not used in this particular circuit application.

The circuits

The various frequencies in the generator and all components are shown on the full schematic in Fig. 4.

A 189-kHz crystal-controlled square-wave generator is the heart of the divider chain. Its output is divided down to 15.75 kHz for horizontal lines and 60 Hz for vertical sync.

It's in the divider chain that the J-K flip-flop really shines. Since each divider block counts each pulse put into it (rather than ignoring most of them as unijunction dividers do), an entirely jump-proof divider results. As a result there aren't any horizontal or vertical hold controls to fiddle with in this generator—it doesn't need them.

This type of divider is also insensitive to supply voltage variations and temperature extremes. Even if a large power-line transient should get into the divider chain, it would fall back into sync within 1/60 second.

If all the flip-flops were used in their simplest divide-by-two mode, we could cascade 9 flip-flops to get a 512-line raster which might require readjusting the TV's hold controls.

To produce the desired 525-line raster, dividing blocks of 2, 3, 5 and 7 are used. The 3, 5 and 7 division is obtained by a variety of feedback arrangements.

For those of you more interested in the divider blocks, Fig. 3 shows timing diagrams for the 3 divider and for one of the two types of 5 dividers used here. Peak-to-peak amplitudes at all points in the divider chain are about 1.5 volts.

For example, in Fig. 4, the horizontal blanking pedestal is formed by taking the 15.7-kHz signal from IC2-a, differentiating it with C3 and R4, and "squaring" the resulting waveform with IC1-b and IC11-c. IC2-b forms the horizontal lines in such a manner that they start and end during the blanking interval.

The crosshatch pattern is generated by allowing either the horizontal or vertical lines to generate the video signal. IC10-a performs the OR function in the circuit.

Dots are formed by allowing a video signal to pass only at the intersection of the horizontal and vertical lines. IC12-e, IC10-d and the inversion inside IC2-b form the AND gate as shown in Fig. 1-d.

A 3.56-MHz oscillator generates the chroma signal. A 189-kHz gate the chroma signal on and off via R8 and C6 to produce the 12 color bursts. (Only 10 are visible because one occurs during blanking and one occurs during the burst period.) IC12-f performs the gating and amplifies as well. C8, R9 and R10 reject the 189-kHz signal but pass the 3.56-MHz signal. Q2 is an emitter follower isolation stage.

The brightness component of the color bar signal is obtained by passing a 189-kHz square wave through S1-A-6 and IC10-b simultaneously with the chroma signal.

IC10-b serves three purposes: it inverts, it prevents modulation during the blanking period via the connection from IC11-c-3, and it brings the amplitude of the various patterns to a constant level so the contrast on the TV screen is the same for all generator patterns.

Q3, L1, C15 and associated components form a common-base rf oscillator circuit.

D1, D2, R21, R22, R24 and R25 form a modulator whose linearity is much better than that of the ordinary one-diode modulator. C14 couples rf to the modulator and R19 couples video to it. Chroma input is via C23. Modulated rf output is across R23.

How to build it

A printed circuit board is a must. Make your own from the pattern on page 45 or order one from the address given in the parts list. Drill according to the parts layout, using a pin vise manually or a hand drill.

When possible, use the specified manufacturers' parts. These were chosen for small size and low cost. C4 should be a high-quality unit to obtain maximum chroma oscillator stability. Similarly, the coil form for L1 should have a locking nut on it to prevent frequency shifting due to vibration. After winding L1, apply several coats of coil dope to secure the wire to the form.

Note that the circuit board is designed for 1/4-watt resistors.

Mount the components as shown. Don't clip the leads on the soldered components until the jumpers on the foil side of the board have been added. The color overprint shows the location of the jumpers R5 and Rect. 1.

To mount the transformer, notch the PC board with a small knife and file about 1/8 inch for the width of the mounting strap. Bend one of the mounting lugs straight down, fit it into the notch, and then continue to bend it around to the foil side. Solder the lug to the foil beneath it after preheating both the lug and foil.

The other lug is mounted with a

(continued on page 94)
GET A BETTER COLOR PICTURE

Don’t let distorted pictures caused by sweep distortion spoil your viewing pleasure. Here’s how to fix them—fast!

COLOR TV 1970

by MATTHEW MANDL
CONTRIBUTING EDITOR

ANY TROUBLES WHICH DISTURB THE waveshape of either the vertical or horizontal sweep signal cause scan distortion. Symptoms include poor vertical or horizontal linearity, severe bending at sides and scan curvature at screen edges (pincushion effects). Such defects have common origins in both color and black-and-white sets, but present greater problems in color because of convergence factors and more complex sweep circuitry.

Pincushion correction

Bending of the scan lines at the outer edges of the raster has always been a problem with large-screen tubes. In b-w sets small magnets are suspended along the tube sides (usually by extension wires or rods from the yoke). These are adjusted so their magnetic fields bend the electron beam slightly and correct the pincushioning.

In color sets three beams must be aligned properly for purity and convergence. Pincushion magnets cannot be used since they would disturb such settings. Instead, special circuits are used which sample vertical and horizontal signals and form parabolic waveforms. These are injected into the sweep system for correction of pincushion effects caused by the wide-angle sweep in large-screen tubes. Because active signals are used (instead of passive magnetic fields) this type of correction is often referred to as dynamic pincushion correction and may be indicated on schematics by the letters DPC.

Typical pincushioning is illustrated in Fig. 1, where a rectangular display shows edge curvature. During the initial setup procedures for a color set, pincushioning should be corrected before convergence adjustments are made. If DPC circuits become defective, convergence will also suffer, but good convergence will be restored.

Fig. 1—Pincushioning is concave curvature in the raster edges. It is due to tube-screen geometry and is a fairly common trouble on large-screen TV sets.

RADIO-ELECTRONICS
when the DPC system is restored to its proper function.

Various types of pincushion correction circuits are used in large-screen color sets. The type depends on whether only the top and bottom of the raster need adjustment, or only the sides. If both require it, more elaborate circuitry is used. Screen size, deflection angle and scan circuitry all have a bearing on final requirements. Some sets use only transformers and RC circuits, while others use a tube for proper waveshaping.

One of the more basic types of pincushion correction is shown in Fig. 2, used in the Silvertone 528.72500 color chassis. Here, two transformers have their primaries in series with the horizontal coil leads. A horizontal sweep signal is produced in the secondaries and shaped by the phase coil and RC network. This signal is applied to the vertical deflection coils and to the vertical sweep signals obtained from the vertical output stage. The correction signals affect the rate of scan at the start and end of the sweep, and can be adjusted by the pot and phase coil for straightening the edges.

When the top and bottom pincushion adjustments are made, vertical linearity should also be checked and readjusted if necessary. Improper vertical linearity will cause a bulging of horizontal lines at the raster edge, while pincushioning will produce a concave effect, as shown in Fig. 1. A bar generator should be used to test the vertical and horizontal scans, using a cross-hatch pattern so both can be kept under observation during adjustments.

A corrector circuit using a tube is shown in Fig. 3 and is found in the Zenith 23XC36 chassis. Here, half of a 6KT8 is used for pincushion correction, with the other half as the second color amplifier. If correction fails initially, try a new 6KT8. Next check for proper grid and plate voltages as indicated on the schematic. A scope test at the plate should show a parabolic waveform having 230 volts p-p at a 60-Hz rate. Note the two isolating capacitors for the horizontal signal injection are rated at 1 kV. Check these for leakage and open and shorted conditions.

Some receivers have more elaborate pincushion correction circuitry, necessitating a more thorough check of components when circuit defects occur. In the Magnavox T920 series chassis, for instance, a dual-triode 12AX7 is used for pincushion correction signal amplification. In the Magnavox T922 color sets, a separate pincushion board is used, with the output signal from a dual-triode 6FQ7.

Other troubles may contribute to sweep distortion when linearity and pincushion adjustments fail to produce results. Shorted turns in the yoke can produce pincushioning, and sweep linearity can be disturbed by defective capacitors, resistors or thermistors within the yoke housing. Also, if a defective yoke has been replaced by one not matched properly to the sweep output system, sweep distortion will result.

Insufficient or excessive drive to the horizontal output tube is another common cause for sweep distortion, with weak tubes in the horizontal oscillator and output sections a usual contributing factor.

In a number of receivers the blue shaping coil in the convergence section is slug-tuned as shown in Fig. 4. Often this control is brought out on the convergence board, but actually is not part of the convergence setup procedure. Thus, when making convergence adjustments, do not tamper with this setting because it will cause horizontal sweep distortion and overload the horizontal convergence components. If adjustments are necessary, refer to the service notes for the receiver for the special procedures necessary.

Distortion from hum

When hum enters the sweep system it will modulate the scan signal and periodically decrease and increase sweep amplitude. Consequently, the raster edge curve may depend on the amount of hum entering the system.

When 60-Hz hum enters the sweep circuitry it will produce a single change in width as shown in Fig. 5, and a dark horizontal area appears (hum bar). The usual cause is cathode-heater leakage in the rf, i.f. or video amplifier tube sections.

With a slight leakage the hum may hardly be visible, but a slight curvature may appear, resembling a pincushion effect. Thus, if pincushion adjustments fail to restore linearity, check tubes for cathode-heater leakage. If the leakage is prior to sound takeoff, some hum will appear in the speaker.

With a full-wave power supply, a hum signal may affect sweep due to filter capacitor troubles in the low-voltage supply, as shown in Fig. 6. Full-wave rectification produces a

![Fig. 2—Pincushioning correction circuit used in some Silvertone TV chassis.](image)

![Fig. 3—Pincushion correction (left) is provided by a triode in Zenith circuits.](image)

![Fig. 4—Avoid blue-shape control (below) when converging. It can cause distortion.](image)
120-Hz signal which will cause two changes in width and a double hum-bar effect. Even with a slight 120-Hz interference (without noticeable hum bars) the double change in width is a clue that pincushioning troubles are not the culprit. With a 120-Hz signal affecting sweep, bending will be present with or without a picture. If the 120-Hz hum is present in the voltage to the rf or i.f. amplifiers only, the hum bars will disappear when a tube is pulled in the i.f. amplifier preceding the detector (in parallel-heater receivers).

In most color sets the low-voltage supply has separate taps and filter sections for various portions of the receiver. Thus, a defective filter capacitor in the supply section feeding the horizontal deflection circuits will cause picture pulling, but without hum bars. With the hum entering stages between the tuner and video amplifiers, however, hum bars are usually visible in addition to the double change in width.

The symptoms shown in Fig. 6 will vary with the amount of hum signal present. In one instance severe pulling was present only for the first few minutes after the set was turned on. The set was a Westinghouse V-2476-1 chassis. Hum bars were only faintly visible, indicating the trouble was in the low-voltage supply feeding the horizontal sweep system. Because of common power supply circuitry, however, some hum voltage was leaking into the video sections and producing faint bars.

The power supply circuit for this receiver is shown in Fig. 7. It uses the voltage-doubling principle, with each of the 160-µF capacitors receiving a separate rectified charge, and delivering double the voltage because they are in series across the output of the B-plus power supply in this chassis.

The upper 160-µF capacitor (next to the filter choke) felt warm to the touch and had a slightly scorched smell. Evidently a partial short or leakage was present when the set was first turned on and before the tube heaters permitted full conduction loading. During warmup the reduced load raised the voltage in the supply and caused the trouble in the filter capacitor. When the heaters came up to normal temperature and the loading effect was in full force, the normal operating voltage was insufficient to cause the temporary breakdown.

A replacement of the suspected capacitor cured the trouble. In this instance, however, a 300-volt capacitor was installed as an added safety feature. Since one of the two doubling capacitors became defective, the other 160-µF, 250-volt capacitor might also give trouble. Thus, this capacitor was also replaced with a 300-volt type. While these two capacitors don't have to be perfectly matched, their ratings should be fairly close to provide for an equal distribution of voltage across them. If one capacitor is too far off, the unequal voltage drops across the two may place a voltage across one that exceeds its rating, causing a short life.

Since chassis removal in a color set is time-consuming, some service technicians take the added precaution of replacing the silicon rectifiers as a matter of routine when replacing filter capacitors. Defects in the low-voltage supply often overload the rectifiers and shorten their life. Thus, while their replacement adds to the service bill, it reduces the chances of a callback and may save the customer an additional service charge in the near future.

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**TOOLS FOR ELECTRONICS**

by **TOM HASKETT**

This issue, starting on the facing page, is the fifth part of our new series of articles on tools for electronics. It starts our description of wrenches. Next month we will continue the series with the next section of the article on wrenches and how to use them. We believe you will find all of this material a handy, practical addition to your R-E Reference Manual.

If you wish you can purchase a special hardcover binder to keep your Reference Manual pages together. It has a dark blue fabric cover and is gold stamped Radio-Electronics Reference Manual. The cost is $1.00, postpaid. Order from N. Estrada, 17 Slate Lane, Central Islip, L.I., N.Y. 11722.
ALL ABOUT WRENCHES

The tool used to turn a hexagonal or square bolthead or nut is called a wrench. There are many kinds of wrenches, for several good reasons. A wide variety of different sizes are needed to work the numerous sizes of nuts and bolts. Then too, some types of wrenches are most effective where you've got lots of work space. Others are needed in tight quarters.

Some wrenches are faster and easier to use than others, but cost more. Usually, it's how much you're going to use a wrench that determines how much you spend on it. You buy a simple and inexpensive wrench if you don't plan to have much use for it. But if you'll be turning a lot of nuts and bolts, it will be worth your while to invest in more specialized and higher quality wrenches.

Since you can work nutdrivers much faster than most right-angle wrenches, you might wonder why you need wrenches at all. Sometimes you have to work a nut or bolt in such tight quarters that a nutdriver can't be used. And nutdrivers are made to handle nuts only up to about \( \frac{3}{4} \)". For larger nuts and bolts, you must use right-angle wrenches.

Basically, there are two types of wrenches. One kind has fixed jaws. These will turn only one specific size bolt or nut. The other kind of wrench has one fixed and one adjustable jaw, and will accommodate several sizes of bolts and nuts. Within the category of fixed-jaw wrenches, there are several types.

The open-end wrench

Typical open-end, double-head wrenches are shown in Fig. 1. (Single-head versions are made, but aren't as useful as the double-

with angles of \( 221\frac{2}{3}°, 30°, 45°, 60°, 75°, 80°, \) and \( 90° \). Other models are made with thin heads, to work in close quarters.

The box wrench

This wrench is so named because the working end completely surrounds or boxes the bolthead or nut, as you can see in Fig. 3. In most

Fig. 3—Box wrenches have two completely enclosed ends. Heads usually have 12 points, though some have only 6. Left is Williams 7727. Right is Husky H-6733. Standard-size box wrenches, (which are double-head types) the head contains 12 points, or notches, arranged in a circle. Since a hex nut has only 6 points, a 12-point wrench head lets you take as little as 1/12 of a turn (30° arc) if necessary in close quarters. Some small box wrenches, however, have only 6 points which restricts the minimum arc to 60°.

The box wrench is a safer tool than the open-end wrench, since it won't slip off the work.

While box wrenches are occasionally made with straight heads and handles, most have offset heads which are convenient for working nuts in tight quarters. In Fig. 3 you see a box wrench with 15° offset heads. In Fig. 4 you see the type with 45° offset heads. In this double-offset type, the heads are parallel to the handle, but not in line with it. The handle is bent up to each head. A few wrenches are made with 10° offset heads.
head type unless you're on a production line and have to handle only one size bolt all day.) The jaws are parallel, and each head is set at a 15° angle with respect to the plane of the handle. This angle gives more torque than a straight head would, and gives you an advantage in working the wrench in close quarters.

An open-end wrench size is identified by the two fractions, which denote the width, in inches, between each set of its jaws. If the wrench in Fig. 1 has a 5/16" head at one end, and a 3/8" at the other; it's known as a 5/16 x 3/8 wrench. These sizes are stamped on the sides of the wrench. The jaw widths are actually from 0.005" to 0.015" larger than the nominal size, so the wrench will easily slip on to bolts or nuts of that size. Wrenches of this type are generally available with jaws from 1/4" to about 1 1/2", in steps of 1/16", 1/32", or 1/64".

Overall wrench length is determined by jaw size. A 1/4" x 5/16" wrench is generally 4" long, a 5/8" x 3/4" wrench about 7 3/8" long, and so on. You need more leverage to turn larger nuts, and the longer handle gives you that greater leverage.

European-made equipment uses nuts and bolts measured in millimeters. At least five companies (Armstrong, Crescent, Proto, Upland, and Williams) make metric-size open-end wrenches, covering generally the range from 8 to 18 millimeters or so.

Probably more useful for chassis work are miniature open-end wrenches. Two typical versions—the double-head and handle-and-blade sets—are in Fig. 2. The type at (a) is generally available with jaw widths from 13/16" to 15/32", and that at (b) from 5/64" to 5/32".

There are several variations to the standard open-end wrenches shown in Figs. 1 and 2. Models are available with straight heads, and

Sometimes you have to work a nut around a corner. For such jobs, the obstruction box wrench is a handy device, as shown in Fig. 5. Each head is offset and the two are 1/16" different in size. The wrench is sometimes called a half-moon.

Box wrenches are generally available in the same sizes as open-end types. As mentioned before, there are two heads; one is usually 1/16" larger than the other. Sizes generally range from 3/8" to 1 1/16", and from 3/16" to 11/32" for miniature types. As with open-end wrenches, handle length increases with jaw size, for greater torque. You can also get wrenches with shorter or longer handles. And thin-head wrenches are also made.

Combination open-end and box wrench

The advantage of the box wrench is that it doesn't slip off a nut, and is therefore safe for loosening a tight nut. But the box wrench is slow when running a nut off the bolt, since you have to pull it up and reset it each time you take a swing. It's faster to use an open-end wrench to run a nut out.

The obvious compromise is the combination wrench shown in Fig. 6, which has a box at one end and an open end at the other. Both heads

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Fig. 2—Miniature open-end wrenches are used for chassis work. Both double-head and handle-and-blade types are available. At far left is Moody model OE-5. Top right is Armstrong H-8. Bottom right is Hunter 24T.

Fig. 5—Obstruction box wrenches are used when you have to work a nut around a corner. Shape sometimes gets them the "half-moon" label. Left, Proto 9501-3. Right, P&C 1730.

Fig. 6—Combination wrench has an open-end and a box end. Both are the same size. The open end is set at 15° and the box end is offset 15°. Wrenches at left are Craftsman. Above, Husky model CC-12.

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Ratchet box wrench

Someone once observed the wasted effort needed to remove a wrench and reseat it when turning a nut in a tight space. The result was the ratchet wrench; a typical version is shown in Fig. 7. It has two 12-point heads, one 1/8" larger than the other. Jaw sizes range from 1/4" to 7/8". The wrench turns the nut in one direction, but slips back for another bite in the other, an action called ratchetting. The ratchet wrench is not usually reversible; you have to remove it and turn it over to reverse direction. But this is no problem, since you are either putting a nut on or taking it off, not both at the same time.

Socket wrench

The nutdriver, a handy little tool, is just one type of socket wrench. Another type is shown in Fig. 8. The socket is boxlike and detachable, and the handle usually has a reversible ratchet mechanism. The socket is locked onto the handle by means of a square shaft on the handle and a square recess on the socket. A spring-loaded ball or the male end fits a matching hole inside the well on the socket. The socket wrench is the fastest type of wrench to use, since the ratchet handle permits the socket to remain on the nut or bolt, and you don't have to remove the handle for turning.

---

**Fig. 7**—Ratchet box wrench eliminates the need to remove a wrench and reseat it when turning a nut in a tight space. Left is the Vaco No. 810. Right is Owatonna model RB-810.

**Fig. 8**—Socket wrenches are really nutdrivers with interchangeable heads. Above left is Williams S-52 ratchet. Above right is Husky CB-43 ratchet. Left is P&C 3010H.

---

**Handle types**

There are quite a few types of handles with which to drive sockets. The standard handle in Fig. 8 comes in round, flat, and long versions. Some have rubber grips for comfort. The flexible hinge (Fig. 11) is useful for angle work. More efficient is the ratchetting flexible hinge (Fig. 12). The sliding T (Fig. 13) is useful where much torque is needed.

---

**Fig. 10**—Sockets come in all styles. Long on far left; short in the center are all by Husky. Flexible socket above is useful to drive a nut at an angle. It's a P&C 3316.

**Fig. 11**—Socket wrench drive handles come in several types. These are the most common ones. Top is Proto 9501-1. Bottom is Owatonna H-275.

**Fig. 12**—Ratchet with a flexible hinge is extremely useful for angle work, though you can't work it as easily as a straight ratchet. At left is Williams model B-54. Above is P&C model 3257.

**Fig. 13**—Sliding-T drive is a great torque amplifier. You can work it with both hands. Top is Proto model 5285. Bottom is Husky CS-70.

---

as you can work it with both hands. Since the crossbar slides, you can work it from side to side to turn a nut in close quarters. The **speeder**
Socket types

There are several sizes and kinds of sockets. The mating device is called a drive shaft, and its size depends somewhat on the socket and nut size. That is, a socket having a larger drive shaft is used for larger nuts, for more strength. There are generally five series, covering sizes as follows:

<table>
<thead>
<tr>
<th>Series</th>
<th>Drive-shaft size</th>
<th>Socket-size range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miniature</td>
<td>1/4&quot;</td>
<td>3/16&quot; to 9/16&quot;</td>
</tr>
<tr>
<td>Light duty</td>
<td>3/8&quot;</td>
<td>1/4&quot; to 7/8&quot;</td>
</tr>
<tr>
<td>Standard</td>
<td>1/2&quot;</td>
<td>5/16&quot; to 1 1/4&quot;</td>
</tr>
<tr>
<td>Heavy duty</td>
<td>3/4&quot;</td>
<td>7/8&quot; to 2 1/4&quot;</td>
</tr>
<tr>
<td>Extra-heavy duty</td>
<td>1&quot;</td>
<td>1 1/16&quot; to 3 1/8&quot;</td>
</tr>
</tbody>
</table>

Metric sizes are also available.

Some sockets are made to handle square nuts, others hexagonal. The four socket types generally available are shown in Fig. 9. The

![Socket Types Diagram](image)

Fig. 9—Typical socket types. Four- and eight-point for square nuts. Six- and twelve-point for hex nuts.

4- and 8-point sockets are made for square nuts, while the 6- and 12-point sockets are made for hexagonal. Generally, smaller sockets are available in all four styles, while larger ones are made only in the 12-point style. The 8- and 12-point sockets are more efficient than the other two, since you get more bites per degrees of handle swing, on a nut in tight quarters.

Fig. 10 compares the standard-length socket with the other types generally available. The deep style is useful for working nuts far down over protruding bolt ends. The flexible socket is used for working nuts at an angle.

(Fig. 14) as its name suggests, speeds up the work, because you hold

![Speeder Tool](image)

Fig. 14—Speeder is a crank to speed-up the work. Looks and operates very much like a carpenter’s brace and bit. At the left is the Owatonna H-283. At the right is Husky CB-85.

the top with one hand and work the middle rapidly in a circle with the other—like a carpenter’s brace and bit.

The spinner or screwdriver handle (Fig. 15) works just like a nutdriver. Stubby models are also available. And Stevens Walden has a

![Screwdriver Handle](image)

Fig. 15—Spinner screwdriver handle works just like a nutdriver with replaceable tips. Top is Husky CM-64; Center, Williams M-106; Bottom is Armstrong model NM-106.

ratchet driver shaped like a screwdriver (type 4056). The flexible spinner (Fig. 16) has a shaft made of coiled spring steel, and will work

![Flexible Screwdriver](image)

Fig. 16—Flexible spring shaft drivers almost work around corners. Top left unit is Prato model 4764. Above is Husky model CM-38.

nuts at odd angles. The L or offset handle (Fig. 17) is used where you have to work around a corner. Here is the Williams model B-30.

![Offset Handle](image)

Fig. 17—L-handle or offset socket handles are used wherever you have to work around a corner. Here is the Williams model B-30.
TAPE RECORDERS ARE FOR FUN. BOTH for the recordist and his audience. With small recorders or large, mono or stereo, one way to get more enjoyment from your recorder is to add a relatively inexpensive accessory—a microphone mixer.

With a mixer you can apply to your own recording all the tricks used by the pros. You can record sound-on-sound, fade voice and music, record voice over music, or mix program sources from several locations. At a party you can record conversations from several "candid" microphones, or record sing-alongs with enough mikes to get everyone into the action. With the family, record the kids singing along with their favorite records. Even have fun alone "disc-jockeying" your favorite records on tape.

**Passive & resistive mixers**

The basic operation of a mixer isn’t at all difficult—in fact, you can make a simple mixer by taking a junction box and mounting three jacks on it. Wiring these jacks in such a way that two input jacks are connected in parallel to a common output jack gives us a simple passive mixer that does not amplify the input signal.

"But," you ask, "If mixers are so simple, why do they get so expensive?" The easiest way to answer this question is to take the simple mixer we have just "built" and see what it would take to turn it into a professional instrument.

The first change is to add a potentiometer to control input levels and provide a pleasing balance of sound at the mixer output. Without these controls one of the input signals could drown out the other.

With this addition, our homemade mixer would have the features of the least expensive mixer on the market, the resistive type (Fig. 1). These small resistive mixers mix inputs from two high-impedance sources to provide a monaural output. They use no power, they’re portable and easy to use.

The simplicity of the resistive-type mixer makes it great for those impromptu recording sessions with the kids. Just plug the mixer into your tape recorder, connect two mikes to the mixer inputs, and you’re ready to record. One microphone can be placed in front of a music source, such as a radio or phono, while your child uses the other to sing along. By using the monitor output on your tape recorder, you can get grandpa and grandchild on tape with a fair share of the volume for each.

![Image of a microphone mixer](image-url)

**Fig. 1—Low-cost resistive mixers combine two inputs for a monaural output.**

The versatility of this type of mixer would make it a recordist’s delight if it were not for two minor drawbacks. One is the fact that with resistance mixers, the voltage level of the output is always lower than the level of the input. The other drawback will cause a problem only if you have a stereo recorder: these small mixers have a monaural output. To solve these problems let’s go back to our homemade mixer.

For stereo capability we have to add another output to give us left and right output channels. Then, to provide a mixing capability, we must add two more inputs, connecting them to the new output in the same way the previous connections were made. Add a switch to direct the two sets of inputs to one of the outputs for mono operation when we want it, and we have what corresponds to the next price level in mixers, a passive stereo/...
mono mixer arrangement.

A stereo/monaural passive mixer can provide for four or more high-impedance sources. Again, because it is passive, no power supply is needed. This type might mix four different sound sources, two on each stereo channel, or all four on one monaural channel. With it you can mix music, voice or other sources and control the level of each channel with an individual volume control.

This type of mixer is useful for recording group sessions. At a party you can position one mike for a music source and still have three left for the "chorus." Adjusting the volume can be done through the monitor output of the tape recorder. However, when using a mixer of this type you'll have to increase the recording level. This brings us to our second problem, losses.

Losses involved with a passive mixer can be due to a number of factors. First, the passive mixer uses simple resistive circuits to mix the incoming signal. This results in a voltage drop across the mixer and a subsequent drop in the input signal level. Another factor is the connecting cable between mixer and input source. Generally, longer connecting cables cause a greater signal loss.

**Adding an amplifier**

To solve these problems, we can add a transistorized amplifier circuit to the mixer. This changes the "passive" designation of our mixer to "active," and boosts the input signal. The amount of amplification depends on what you plan to use the mixer for. You can provide enough amplification to compensate for losses and possibly provide a slight gain, or build in enough gain so the unit could be used as a preamplifier for low-level inputs.

Mixers solve the problems inherent to passive mixers. They have no loss (in fact, some provide considerable gain) and, by separating outputs, can be used to feed two separate signals into both the right and left stereo channels of any amplifier or recorder (Fig. 2).

With this type of instrument you can match most of the tricks used by professionals and come up with some top-rate home recordings. For example, you can "stereoize" old monaural records by taking your phono output and running it to two filters, one bass and one treble, then running the leads to the mixer. The mixer then provides preamplification and balance control for the stereo tape.

However, in using a phono with the mixer, you're liable to encounter the need for another feature some mixers have, some don't— phono equalization. This is a built-in circuit that compensates for the special recording characteristics used in most modern recordings; equalization will also balance the special response characteristics of magnetic phono cartridges.

Another factor that can affect an "active" mixer's usefulness is its power supply. If portability is important, the best bet is a battery-operated mixer. On the other hand, if the mixer will always be used where commercial power is available, a "plug-in" type is preferable. The choice depends solely on mixer use.

A useful mixer feature is a master gain control—a volume control wired so you can vary the overall output of the mixer without touching individual gain controls. This control lets you do program fades easily, without adjusting several knobs. Another feature available in some models is automatic impedance matching to match the impedance of your inputs (mikes, phonos, etc.) to the input on your tape recorder. Without built-in impedance matching you'd have to buy a separate transformer to match each of your sources to your tape recorder. Fig. 3 shows a mixer that has all these features for the serious recordist.

Mixers can be especially useful for recording sounds that can't be taped at home. For example, a friend recently discovered an old player piano in an abandoned garage. After getting the piano working, he found that by some wild chance the acoustics of the garage were perfect for the piano. He decided to make a recording of the piano right in the garage, using several mikes in different sections of the "auditorium." Because he used professional-quality equipment to make the recording, he now has a top-notch rendering of the music produced in this somewhat unique set of circumstances.
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**THE CIRCUITS**

The simple shunt stage was once the only type used to regulate high voltage in color receivers, and still appears in some new models. Nowadays, a hold-down circuit is added to most chassis that have shunt regulators.

The triode tube, connected across the line from the high-voltage rectifier cathode to the color-CRT second anode, is a variable load. The CRT beams offer more or less load, depending on brightness content of the picture. The regulator tube draws more current when the CRT load is light (picture dark) and less when the CRT load is heavier (picture bright). That keeps current constant through the high-voltage rectifier, limiting any high voltage ups and downs.

Think of this system as three separate circuits. One is the regulator stage. It consists of the tube, R4, R5, R6, C2, and R7. The dashed lines show how it would be wired without the hold-down circuit.

The second is the protective biasing circuit for the horizontal output stage. It comprises C1, D1, R2, and R1. Finally, there is the hold-down safety circuit that consists of R3 and D2.

These three circuits do interact, but they're easier to understand separately.

---

**SIGNAL BEHAVIOR**

The only signal involved is WF1, the flyback pulse fed by C1 to bias diode D1. It's a positive-going pulse of short duration. But, ac-coupled to the diode, it can be considered a long-duration, negative-going pulse, too. It is rectified easily into 130 volts of negative dc.

Capacitor C2 shunts away any horizontal-pulse "hash" that might get to the regulator grid from the boost B-plus line.

**DC DISTRIBUTION**

Stage operation is mainly dc. The current load that regulates high voltage flows through D2, R7, and the tube (cathode to plate). Regulator current is controlled by bias between grid-pin-5 and cathode-pin-1.

During normal operation, D2 conducts and makes a direct connection to the B-plus source. The 350 volts goes to cathode-pin-1 through R7.

Voltage at grid-pin-5 is from divider R4-R5-R6, which is connected from boost B-plus to ground. Resistor R6 determines total resistance from grid to ground and sets the bias point. By affecting regulator conduction, R6 adjusts the high voltage value. Notice that true bias—usually 10 to 15 volts—is the difference between the two.
Use this guide to help you pinpoint the faulty part.
Measure the six key voltages with a vtvm.
For each, move across to the column that describes the change you find.
Notice which parts the chart says might cause that change.

Finally, notice which parts are repeated in whatever combination of voltage changes you find.
Test those parts individually for the defect described.
For more guides to narrow down the faulty part, see Screen Symptoms Guide.

RADIO-ELECTRONICS

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Use this guide to help pin down fault possibilities, although the Voltages Guide is much more helpful. Use direct probe of the scope. If amplitude or shape is wrong, check source of pulse as well as parts listed in chart above.

Scope sweep should be set at H or at about 5 kHz.

voltages on cathode-pin-1 and grid-pin-5.

Meanwhile, bias for the receiver's horizontal output stage is developed by D1 rectifying the pulse fed to it. A strong negative voltage appears at the anode of D1. This negative dc is led toward the horizontal output grid by R2.

Before it gets there, however, it meets a positive dc brought from the regulator cathode circuit by R3. The difference between the positive and negative voltages is the net dc fed to the output stage by R1. The output stage develops grid-leak bias of its own, but the normal 45-volt bias (key-point-A) is influenced by the net voltage from the bias and hold-down circuits.

Hold-down is not tricky to understand. If the regulator fails, which might let high voltage rise to an unsafe level, current through the tube and R1 virtually quits. The anode of D2 becomes much less positive because the diode no longer conducts. At key-point-B, with less positive voltage coming through R3, negative voltage from D1 dominates. The voltage fed to the output grid by R1 becomes more negative and horizontal sweep output is reduced. Less flyback energy in the high-voltage rectifier means less dc high voltage.

This hold-down circuit is so effective, it keeps high voltage from rising more than 2 or 3 kV above normal. All circuit faults, with the exception of an open D2, cause reduced high voltage.

**SIGNAL AND CONTROL EFFECTS**

Signal signal strength has no effect on voltages in this stage. You may see small voltage changes between bright and dark scenes, brought about by the changing CRT beam current.

Varying R6 alters the voltage at grid-pin-5 and raises or lowers the high voltage. At full resistance, voltage at grid-pin-5 may be as high as 340 volts; at low resistance, grid-pin-5 may have only 325 volts. High voltage, which is nominally 20 kV in this set, can be varied between 18 and 23 kV by R6.

**QUICK TROUBLESHOOTING**

A quick check of WF1 with an oscilloscope establishes whether it is okay. If not, the trouble is C1, D1, or R1—or it's elsewhere in the set.

Then, with a dc voltmeter, test the regulator. Measure boost B-plus, then the regular B-plus applied to the D2 cathode. Clip the voltmeter to grid-pin-5 and twist the high-voltage adjust control up and down. It should vary the voltage at least 10 volts. If not, R6 or C2 is probably bad.

Then, in sets with the hold-down circuit, check the negative voltage developed across D1, at key-point-C. Then measure key-point-B; if voltage there is low or positive, there's too much positive dc coming through R3 or too little negative coming through R2.

Finally, check key-point-A. Not enough negative voltage there might be caused by trouble outside the regulator and hold-down stage—weak drive, for example. Check the diodes without disconnecting them. Just turn the set off and measure each diode with an ohmmeter. The forward reading should be less than 10 ohms; the reverse, near infinity.

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by ALAN JAMES

You can install protective hold-down circuits in those millions of chassis still around with shunt-type high-voltage regulators.

An improperly adjusted high-voltage regulator can cause x-radiation above the 0.5 mR/hr maximum standard set by The Bureau of Radiological Health (BRH). Yet, the BRH has assured the public that even several times that amount does no harm, either physically or genetically, to humans. But some people say: Why even take the chance? Eliminate the main possible cause—too much high voltage.

Set manufacturers have redesigned many of their chassis. More than half the 1970 receivers no longer use a shunt-type high-voltage regulator. Those that do usually have a hold-down circuit added. It prevents high voltage from exceeding a safe value, even if the regulator goes bad. In fact, with a properly designed hold-down circuit, the regulator can't even be misadjusted by a careless technician or a screwdriver-happy owner.

Here is a simple and inexpensive design you can add to almost any shunt regulator. With this add-on circuit in place: (1) no one can turn the high voltage too high; (2) a regulator fault activates the hold-down circuit, limiting high voltage; and (3) a defect in the hold-down circuit shrinks the picture or makes it fuzzy, giving notice of trouble.

Reviewing a shunt regulator

Fig. 1—Basic triode regulator acts as a variable load across the high-voltage line to the CRT second anode.

You can install protective hold-down circuits in those millions of chassis still around with shunt-type high-voltage regulators.

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Reviewing a shunt regulator

A schematic of the shunt regulator usually used in modern color sets is in Fig. 1. Normal conduction for the tube is set by voltage divider R1-R2-R3, connected across boosted B-plus. Potentiometer R1 sets the voltage drop across R3, and what's left is applied to the grid.

The cathode gets a positive voltage from B-plus (usually from the vertical-output-and-centering circuit)
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The special resistor used in the Motorola chassis contains thirty-four 4.7-megohm units, sealed in epoxy. You’ll find this one in the TS-914 chassis and from there on (Fig. 4).

The top (HV) part is 132 megohms, and the lower part 28 megohms. From the bottom, it goes to a 10-megohm variable resistor for control. In most of these chassis, you’ll find 22 megohms from the control slider to ground.

The big resistors, both the special high-voltage and the encapsulated types, can change value. They do open occasionally. When you can read normal high voltage “at the top”, but the focus voltage is either too low or too high, and out of range of the focus-control variation, you’ll probably have to install a new resistor.

Ordinarily you won’t have to read the focus voltage to tell when it’s off. The well-calibrated eyeball will show you the scanning lines if they’re sharp and visible all the way across the screen. Focus voltage isn’t hard to read, however. Many voms have a 5,000-volt dc range, and can be used to check focus voltage with your regular high-voltage probe.

The scanning lines ought to be the final test, though. Normal variation over the range of the focus control should be about 1,000 volts. This will usually be from 4,000 to 5,000 volts, or very near to it. If it will do that, it’s probably OK.

If you can’t get focus with the focus voltage at 5,000 volts and still going up, check the high voltage (on any circuit, not just the voltage-divider type!) You’ll probably find it running away too high.

In some Motorolas, you’ll find the focus voltage returns to ground through the degausser. If these chassis are operated on a test-jig, etc., ground the wiper-arm of the focus control, or the rater will be out of focus (see Fig. 4).

EQUIPMENT REPORT

B & K "Dyna-Flex Probe"

I’ve always been a good prospect for anything that’ll save me time, so I enjoyed using the B & K “Dyna-Flex Probe”. Unless you’re one of the fortunate-type technicians who has three hands, this will be very helpful. (Did you ever try to make three wee test clips, hold all at the same time, on a PC board with only little blobs on each terminal?)

This is a probe; it has three wires going straight through the good sized handle, and terminating in three very sharp, spring-loaded, ball-jointed tips. The tips are color-coded, so that you can tell which lead goes to each pin. The leads have miniature test-clips; these can be used to hook the probe to the leads of your transistor tester, vtm, tvm, etc., or to hook up resistors, capacitors, or even transistors for substitution on a PC board.

To make in-circuit transistor tests with the Dyna-Flex probe, just check the base arrangement of the transistors. For instance, E-B-C counter-clockwise. Now, hook the probe’s leads to the clips of your transistor tester to get the same arrangement, and away you go.

Two of the pins, the yellow and blue wires, are longer; so, set one of these on the collector, then move the probe-body over until the other is over the emitter solder-blob, and push. This leaves the third (base) pin open until the others are connected. Now, just lean the probe body over a little, lining up the green pin with the base dot, push, and there you are. You can easily hold it in place with one hand, while you set up the transistor tester and operate it with the other. The exceedingly sharp tips of the pins will dig right into a solder-joint, through resist, varnish, etc.

You can hook up only the two long pins to the vtm, etc., and take that handy base-emitter voltage reading on all of the transistors in a stereo amplifier, TV i.f. strip, etc., in a very little time; much less than standard test prods or clips. The ball joints on the pins make them easy to set up; just jab one into one joint, then move the probe over until you can reach the other. You don’t have to space them or set them beforehand.

The wires are coded yellow and blue for collector and emitter (in most basings) and green for base, which is about as near as we get to a standard color coding for transistor bases. Your transistor tester probably has different colored wires, but it’s no trick to hook them up.

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MULTIMETER, 100K ohms/V, model TE-241, has built-in transistor tester for Lm and alpha or beta tests of npn and pnp transistors. Taut-band meter movement protected by electronic overload circuit. Ranges: dc: 0 to 0.12, 0.6, 3, 12, 30, 120. Ohms—10K, 1000K, 100 meg. Ac: 0-6, 30, 120, 600. Decibel: -30 dB to +55 dB, 3% accuracy. Size 5 x 6 1/4 x 2 3/4". $44.98. Olson Electronics, Inc., 260 So. Forge St., Akron, Ohio 44308.

Circle 47 on reader service card

COLOR BAR-PATTERN GENERATOR, model IG-28, uses integrated circuitry to produce six 9 x 9 patterns—lots, cross hatch, shading bars, color bars, vertical and horizontal lines. Has clear raster for adjusting purity without upsetting age. Front panel has variable tuning for channels 2 through 6, plus and minus video output, sync output, two ac convenience outlets, built-in gun shorting circuits and grid jacks, vectorscope capability, switchable crystal, controlled sound carrier, copper-banded transformer to eliminate stray fields, zener-regulated power supply and 3-wire line cord. Beige and brown. Kit, IG-28, $79.95. Factory-wired and tested, IGW-28, $114.95. Heath Co., Benton Harbor, Mich. 49022.

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STEREO RECEIVER. The SX-150/07/D features a microphone mixing circuit, with mike jack and level control on the front panel to enable user to sing along with records and to record voice and record on tape if desired. Other features include a speaker-selector switch for five switching arrangements using three pairs of speakers and a switch providing separate, independent use of the preamplifier and power amplifier sections. FM HIF usable sensitivity 1.7 µV. Includes FET front-end and 180-watt audio output. $399.95—Pioneer Electronics U.S.A. Corp., Farmingdale, L.I., NY

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PHONO CARTRIDGE V-15 Type II. Improved trackability in bass and mid-frequencies compared with its predecessor. Tracks most records at 3% gram, including those containing heavily modulated bass drum, tympani, organ pedal, bassoon, tuba, or piano passages. The improved V15 Type II is $67.50. Owners of older V-15 Type II cartridges can better performance by replacing their present stylus with the VNX5 improved elliptical stylus at $27.—Shure Brothers Inc., Evanston, Ill.

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150-175 MHz, respectively) are Auto-Scan models that signal-search and automatically lock on a signal on any one of 8 programmed channels. A priority-channel signal locks in to the exclusion of all other signals. Available with 8 crystal-controlled channels. Plug-in crystals allow instant frequency change.

The four receivers are for narrow-band (±5 kHz) operation. $169.95 for the 24-channel models and $189.95 for the Auto-Scan types—Sonar Radio Corp., Brooklyn, N.Y.

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COLOR LIGHT ORGAN, LO-104, 3-channel organ provides 1.5 kilowatt output. Can transform a large room into a psychedelic light-sound environment.—Science Workshop, Box 393, Bethpage, N.Y.

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Introducing The Advanced New Heathkit 60-Watt AM/FM/FM Stereo Receiver

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$225.00*

Third In The New Generation Of Superb Solid-State Receivers From Heath...And Low In Cost

- Advanced solid-state circuitry with 108 transistors, 46 diodes and 5 integrated circuits
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- Less than 0.25% Harmonic & IM Distortion at any power level
- Frequency response from 6 to 35,000 Hz
- Direct-coupled, transformerless outputs for lowest distortion and phase shift
- Dissipation-limiting circuitry protects outputs from damage even with a short circuit
- Assembled, aligned FET FM tuner has 2.0 V u/v sensitivity to give you more listenable stations
- Ball-bearing inertia flywheel tuning for smooth, accurate station selection
- Preassembled, factory aligned FM IF circuit board speeds assembly
- Eliminates IF alignment, gives 35 dB selectivity
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- Pushbutton Mute control attenuates between-station FM noise
- Blend control reduces on-station FM noise
- With a push of a button, Tone-flat pushbutton disables bass & treble controls for perfectly "flat" response
- New linear motion controls for volume, balance, bass & treble
- Individually adjustable level controls for each input including tape monitor eliminate annoying volume changes when switching sources
- Switches for two separate stereo speaker systems for stereo sound in two different locations
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- Two front panel tuning meters give exact station selection
- Stereo indicator light
- Front panel stereo headphone jack
- 200 & 75 ohm FM antenna inputs
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- Built-in AM rod antenna swivels for best reception
- Massive power supply includes section of electronically regulated power
- New Heath modular plug-in circuit board design speeds assembly, aids servicing
- Built-in testing facilities aids construction, simplifies servicing
- Circuit board & wiring harness construction for easy, enjoyable 25 hour assembly

Ahead of its time...those who want to hear stereo high-fidelity as it will sound in the 70's can begin right now, at a modest price, with the Heathkit AR-19. Its design is an extension of the advanced circuitry concepts first introduced in the AR-15. These receivers are truly of a new generation...they've expanded audio engineering horizons and set the pace for the 70's.

Field Effect Transistor And Integrated Circuit Design. The AR-19 uses advanced semi-conductor circuitry...including five integrated circuits, with a total of 108 transistors and 45 diodes. The pre-assembled FM tuning unit uses an RF field effect transistor to provide high sensitivity and low cross modulation with no overloading on strong local stations. In the AM RF circuit also, field effect transistors give superior sensitivity and large signal handling capacity.

Ideal For Most Home Stereo Installations. The AR-19 is just right for the medium and high efficiency speaker systems that are so popular today. It can form the nucleus of a fine stereo system...and will probably be the most attractive part, thanks to its rich oiled pecan wood cabinet and to the "Black Magic" front panel. The scale and dial readings appear only when the power is on.

Features To Aid The Kit Builder. All 8 circuits of the AR-19 snap in and out in seconds. Think of the resulting convenience and ease of assembly! In addition, the AR-19 has built-in test circuitry...two test probes with the front panel meter for indications. With it, the user can check out circuit parts without the need for expensive external test equipment. Proper use of this feature is fully covered in the manual.

Don't Wait For Something Better To Come Along...it'll be a long wait. Upgrade your stereo system now, with this outstanding receiver value.

Kit AR-19, 29 lbs............................................................................................................$225.00*
Assembled AE-19, cabinet, 10 lbs.................................................................................$19.95*

PARTIAL AR-19 SPECIFICATIONS - AMPLIFIER: Continuous power output per channel: 20 watts, 8 ohms. IHF Power output per channel: 30 watts, 8 ohms. Frequency response: (1 watt level): 1-20,000 Hz. Power bandwidth for constant 0.25% THD: Less than 5 Hz to greater than 20 kHz. Harmonic Distortion: Less than 0.25% from 2 Hz to 20 kHz. 20 watts rms output. Less than 0.1% at 1000 Hz. IM Distortion: Less than 0.25% with 20 watts output. Less than 0.3% at 1 watt output. Hum and noise: Phone input, 45 dB. Phone input sensitivity: 2.4 millivolts, overload, 155 millivolts. FM: Sensitivity: 2.0 uV. IHF Volume sensitivity: Below measurable level. Selectivity: 35 db. Image rejection: 90 db. IF Rejection: 90 db. Capture ratio: 2.5. Total harmonic distortion: 1% or less. IM Distortion: 0.5% or less. Spurious rejection: 90 db. RF STEREO: Separation: 35 db at midfrequencies. 30 db at 50 Hz. 25 db at 1 kHz. 20 db at 15 kHz. Frequency response: ±0.1 db from 20-15,000 Hz. Harmonic distortion: 1.5% or less @ 1000 Hz with 100% modulation. 19 kHz & 38 kHz Suppression: 50 db. SCA Suppression: 50 db. AM SECTION: Sensitivity: Using a radiating loop, 130 V/M @ 1000 kHz. Selectivity: 25 db at 10 kHz. Image rejection: 60 db @ 670 kHz, 60 db @ 1400 kHz. IF Rejection: 60 db @ 1000 kHz. Harmonic distortion: Less than 2%. Hum & noise: 40 db.

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New Heathkit 100-Watt AM/FM/FM-Stereo Receiver
World's finest medium power stereo receiver...designed in the tradition of the famous Heathkit AR-15. All Solid-State...65 transistors, 42 diodes plus 4 integrated circuits containing another 36 transistors and 24 diodes. 100 watts music power output at 8 ohms...7 to 60,000 Hz response. Less than 0.25% distortion at full output. Direct coupled outputs protected by dissipationslimiting circuitry. Massive power supply. Four individually heat sunk output transistors. Linear motion bass, treble, balances and volume controls. Pushbutton selected inputs. Outputs for 2 separate stereo speaker systems. Center speaker capability. Stereo headphone jack. Assembled, aligned FEI FM tuner has 1.8 uV sensitivity. Two tuning meters. Computer designed 9-pole L-C filter plus 3 IC's in IF gives ideally shaped bandpass with greater than 70 dB selectivity and eliminates alignment. IC multiplex section. Three FET's in AM tuner. AM rod antenna swivels for best pickup. Kit Exclusive: Modular Plug-In Circuit Boards...easy to build & service. Kit Exclusive: Built-In Test Circuitry lets you assemble, test and service your AR-29 without external test equipment. The AR-29 will please even the most discriminating stereo listener.

Kit AR-29, (less cabinet), 33 lbs...............................$285.00*
AE-19, Assembled oiled pecan cabinet, 10 lbs...............$19.95*

New Heathkit Deluxe 18-Watt Solid-State Stereo Phono
Looks and sounds like it should cost much more. Here's why: 16-transistor, 8-diode circuit delivers 9 watts music power per channel to each 4½" high-compliance speaker. Speaker cabinets swing out or lift off...can be placed up to 10' apart for better stereo. Has Muerto's best automatic, 4-speed changer — 16, 33-1/3, 45 & 78 rpm. It plays 6 records, shuts off automatically. Ceramic stereo cartridge with diamond/sapphire stylus. Has volume, balance & tone controls. Changer, cabinet & speaker enclosures come factory built...you build just one circuit board...one evening project. Wood cabinet has yellow-gold & brown durable plastic coated covering. This is a portable stereo you can take pride in.

Kit GD-109, 38 lbs..................................................$74.95*

New Heathkit 80-10 Meter 2 KW Linear Amplifier
Incomparable performance and value. The new SB-220 has 2000 watts PEP input on 1200 and RTTY. Uses a pair of Eimac 3-900Z's. Purtuned broad band pi input coils. Requires only 100 watts PEP drive. Solidstate power supply operates from 120 or 240 VAC. Circuit breaker protected. Safety interlocked cover. Zener diode regulated operating bias. Double shielded for max. TVI protection. Quiet fan — fast, high volume air flow. Also includes ALC to prevent over-driving. Two meters: one monitors plate current; the other is switched for relative power, plate voltage and grid current. Styled to match Heath SB series. Assemblies in about 15 hours.

Kit SB-220, 95 lbs.............................................$349.95*

New Heathkit
Solid-State Portable
Fish-Spotter
Costs half as much as comparable performers. Probes to 200 ft. Spots individual fish and schools...can also be used as depth sounder. Manual explains typical dial readings. Transducer mounts anywhere on suction cup bracket. Adjustable Sensitivity Control. Exclusive Heath Noise-Reject Control stops motor ignition noise. Runs for 80 hrs. on two 6 VDC lantern batteries (not included). Stop guessing — fish electronically.

Kit MI-29, 9 lbs..................................................$84.95*

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Let its flashing indicator light guide you through strange waters...day or night. Sounds to 200 ft. Has Noise Rejection and Sensitivity control. Operates from your 12 VDC boat battery. Sun-shielded dial. All solid-state.

Kit MI-19-1...with thru-hull transducer, 7 lbs.............................$69.95*
Kit MI-19-2...with high speed transom mount, 7 lbs.......$69.95*

JANUARY 1970

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AEROVOX HAS EVERY EXACT REPLACEMENT TWIST PRONG AFH ELECTROLYTIC

Why fool with "jerry-rigged" electrolytics when there's an Aerovox exact replacement to give you the right rating and the right size? Aerovox actually stocks all twist prong AFH electrolytics—this means off-the-shelf availability . . . not "we'll build it for you if you order it." Delivery.

Available in singles, doubles, triples and quads, these popular types are now manufactured in new values for filter bypass applications in color TV as well as radio, black and white TV and amplifier equipment. Many values are now being used for industrial applications.

Aerovox AFH Twist Prong Electrolytics feature ruggedized prongs and mounting terminals, high purity aluminum foil construction, improved moisture resistant seal and 85° C operation. Here is the quality you need to protect your professional reputation.

Go to your Aerovox Distributor for a perfect electrolytic fit—he will deliver exactly what you want in less time than it takes to talk. Ask him for the new Aerovox Service men's Catalog #SE-569 or ask us. We'll be happy to send one your way.

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stereo and monaural tape. Pushbutton operation with record-interlock and pause-lever for editing. Intercom protects with door answering from any remote amplifier. $49.95 in kit form. $65.00 completely assembled. Edison Instruments, Inc., 54 West Cherry St., Rahway, N. J. 07065
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Write direct to the manufacturers for information on items listed below:

STEREO/INTERCOM SYSTEM, built-in, includes Master Unit, model 2071, with solid-state dual channel amplifier and FM stereo, FM/AM radio tuner. Fold-In-Wall record changer N2073. Tape recorder, model 2408, uses 4-track stereo.

U.S. GOV'T ELECTRONIC SURPLUS

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All booklets, catalogs, data sheets and other literature listed here with a Reader's Service number are free for the asking. Turn to the Reader's Service Card facing page 81 and circle the numbers of the items you want. Then detach and mail the card. No postage required!

RECORDING BASICS, a 24-page booklet, offers tips on proper selection of magnetic tapes, recording techniques and recording procedures in non-technical terms. It also defines various types of tape recorders and illustrates the proper techniques for editing and splicing magnetic tapes as well as maintenance tips for recorders. Write to 3M Co., Magnetic Products Div., Market Service Dept., 3M Center, St. Paul, Minn. 55101

Circle 76 on reader service card

JAPAN ELECTRONICS DIRECTORY is a 16-page book listing the manufacturers of Japanese consumer electronic products and parts; hi-fi sets and components; auto radios and tape players; communications systems; computers; electronic measuring equipment; radar equipment; automatic control systems; transformers, relays, coils, capacitors and other electronic devices. Material obtained by enclosing a 6¢ stamped, self-addressed #10 envelope to:
Electronic Manufacturers' Directory, Japan Light Machinery Information Center, 437 5th Ave., New York, N.Y.

CRYSTAL BULLETIN, 12 pages, contains a list of quartz crystals in the range from 50 kHz-200 kHz. Complete dimensional data for standard and custom units are included along with revised chart listing specifications on all military type crystals.—K-W Industries Inc., Prague, Okla.

Circle 78 on reader service card
NEW COLOR TV CIRCUITS

(continued from page 42)

With this additional voltage, \(V_{in}\) (Fig. 7b) is the resultant. Notice the resultant is phase-shifted slightly from \(V_s\) and therefore from \(V_i\) and \(V_r\). The phase shift shown is approximately the resultant phase shift with minimum \(V_s\) (R at maximum resistance setting). When more \(V_s\) is added by decreasing resistance R, the phase of the resultant is shifted toward \(V_i\) (Fig. 7c). In this case, resistance R is at minimum and effectively out of the circuit. Only a small fixed resistor remains, which limits the total phase shift to almost that of \(V_{in}\). Total phase shift from maximum to minimum R ranges from \(V_{in}\) to \(V_{in}^{*}\), the effective tint control range.

Noise-immune and sync and agc

Another interesting solid-state circuit is the novel keyed age and noise-immune sync used in the RCA CTC 42X. The circuit is shown in Fig. 8. The age system operates by comparing the amplitude of the sync tips with an 18-volt reference level. Composite video (2.4 V p-p) at the emitter of the second video amplifier is riding on a 15.4-volt dc level which places the sync tips at 17.8 volts. This signal is fed to the base of Q501, the age keyer. The emitter of Q501 is biased at 17.2 volts so that (with the inhibit 0.6 base-emitter voltage drop) the transistor cannot conduct on signal voltages below 17.8.

On signals too weak to develop the 17.8-volt sync-tip amplitude needed to cause the Q501 to conduct, the age-controlled rf amplifier and the first and second i.f. amplifiers operate at maximum gain.

When the signal level increases to the point where the sync-tip level exceeds 17.8 volts, Q501 conducts during the horizontal pulse interval. This conduction creates a negative charge on the 330-pF capacitor and the age lines.

Low-level signals that are above the age threshold develop a negative age voltage that acts to reduce only the gain of the i.f. amplifier stages. As signal level further increases, the rf amplifier gain is reduced until the tuner is operating at minimum gain. As the signal level increases beyond around 100 mV the i.f. stages are again influenced by age.

Transistors Q504, Q502 and Q503 prevent incoming noise pulses exceeding the blanking level from causing false triggering of the horizontal and vertical sweep oscillators. Sync amplifier Q502 is a common-base amplifier operating with 15.4 volts of emitter bias via direct cou-

plng to the emitter of the second video amplifier. The signal (with sync positive) is developed across the 1,200-ohm collector resistor. The 470-pF capacitor strips off the high-frequency video information while the sync pulses are fed to the sync separator.

The sync separator base is supplied from a regulated 18-volt source. Its collector is fed from the 280-volt line and clamped to ground by a 18,000-ohm resistor, consists of negative-going pulses of around 36 volts. These pulses are differentiated and integrated to provide horizontal and vertical sync.

Noise gate Q504 (a pnp transistor in a common-base circuit) has its base connected to 18 volts while the composite video with positive-going sync is fed to its emitter. On a noise-free signal, the 17.8-volt sync tips cannot drive the stage to conduction. On the other hand, noise pulses that exceed the sync-tip level by only a few millivolts will drive the noise gate to conduction. The noise gate output develops a positive-going pulse across R510 with amplitude high enough to drive the sync amplifier base to cutoff for the duration of the noise pulse.
TRY THIS ONE

MATCHING MICROPHONES
To tell if a pair of microphones is well matched, place the two side by side as close together as possible. Hook them up, out of phase, to a single input. The response should be almost nil for sounds (voice) directed to the mikes. If this is not so, either they have different response curves or they were out of phase to begin with. —Harry J. Miller

AUTOMATIC SPEAKER SWITCHING
If you have only one hi-fi speaker set up and want to use it for all your equipment such as TV, phonograph, radio and tape recorder, you'll find the switching rather complex. And, you must remember to switch the speaker to the desired equipment each time you use it. Since no two instruments are in use at the same time, I use reed switches for automatic switching.

A switch is connected as shown in the "high" side of each output transformer secondary lead. The switch is mounted on the filter choke of each instrument so it closes when that set is turned on. The common sides of all the output circuits are connected together and to one side of the speaker voice coil. —Stanley Zlotkowski, Sr.

(Do not use this scheme on transformerless (ac-dc) equipment. You may inadvertently connect the hot side of the power line to all your other equipment. —Editor)

BATTERY-ELIMINATOR PROTECTOR
I use an Eico 1060 battery eliminator/charger when servicing transistor radios. This unit packs quite a wallop if its leads are shorted.

To prevent damage, I insert a No. 47 pilot lamp in series with one of the leads. In the event of a short, the lamp limits the current and lights to visually indicate a short circuit. This lamp has no affect on the 8-10 mA that is drawn by most small transistor radios. —Oscar Blair

QUICK REPAIR FOR OLD VOLUME CONTROLS
Many times, old radios with volume control trouble are brought in for repairs. In most cases, washing out the control is all that is needed. But often, old controls are sealed and cleaning fluid cannot be injected.

I have been able to avoid replacing these controls by drilling a tiny hole in the case of the control so cleaning fluid can be injected. Here is how it's done. Use a large diameter drill (see drawing) and don't drill all the way through the cover. Go almost through.

Then take a sharp ice pick and puncture the partially drilled hole. Make only a tiny opening, just large enough to insert the needle of the injector. Do not use a small-diameter drill for making the hole; it may go through and damage the control.

This scheme has enabled me to avoid replacing controls in many old radios. —Joseph D. Amorose

(continued on page 100)
COMING NEXT MONTH

FEBRUARY 1970

Build R-E's Pulse Generator
Professional-quality instrument easily matches generators costing twice as much. Variable frequency, pulse width and delay.

30 Projects with the CA3035
Learn how this versatile linear IC from RCA works. Then tackle the useful projects that interest you.

All About Capacitors
An expert shows you which capacitors to use in specific circuit applications, and what the important differences between capacitor types are.

Build an Electronic Reverb
Add this circuit to your electric guitar for spectacular echo effects.

Plus other features in hi-fi and TV

Why Do You Read So Slowly?

A noted publisher in Chicago reports there is a simple technique of rapid reading which should enable you to increase your reading speed and yet retain much more. Most people do not realize how much they could increase their pleasure, success and income by reading faster and more accurately.

According to the publisher, anyone, regardless of his present reading skill, can use this simple technique to improve his reading ability to a remarkable degree. Whether reading stories, books, technical matter, it becomes possible to read sentences at a glance and entire pages in seconds with this method.

To acquaint the readers of this publication with the easy-to-follow rules for developing rapid reading skill, the company has printed full details of its interesting self-training methods in a new booklet. “How to Read Faster and Retain More” mailed free to anyone who requests it. No obligation. Send your name, address, and zip code to: Reading, 835 Diversey Parkway, Dept. 684-011, Chicago, Ill. 60614. A postcard will do.

Circle 112 on reader service card
LOW-VOLTAGE UNIJUNCTION

The 2N5431 is a Motorola unijunction transistor designed for operation on supply voltages as low as 4 volts. Made by improved construction techniques, this UJT has an emitter current leakage of only 10 nA, about 1/100th the leakage of some earlier types. Likewise, peak point leakage current is only 0.4 µA maximum at Vem of 25 V and 4.0 µA at 4 V. These two characteristics are critical for long-time-delay, low-leakage circuits.

Other outstanding characteristics are intrinsic standoff ratio (r) range of 0.72-0.80, base-to-base resistance Rbb range of 6,000 to 8,500 ohms. Maximum reverse emitter voltage (Vem) is 30 V, maximum emitter current is 50 mA rms, power dissipation is 300 mW and maximum emitter saturation voltage is 3V.

The 2N5431 is in a TO-18 case. $3.25 in lots of 1000.

FAIRCHILD SH2200

The SH2200 is a new hybrid-circuit high-performance lamp and relay driver featuring a 50-volt output and a sinking current of 500 mA at 6 volts. This Fairchild multichip device is a pin-for-pin replacement for the firm's SH2001, a lower-voltage lamp driver that sinks up to 250 mA.

Designed for logic flexibility, the SH2200 provides a combination of four NAND gates and an inhibit (NOR) input. It can interface with all other current-sinking logic circuits.

Besides being useful as a lamp and relay driver, the SH2200 will serve also in display systems, tape readouts, go-no-go testers and readouts of computer equipment and for solenoid, memory and clock driving.

The device is available in a plastic dual-in-line package and temperature range of 0° to +70°C at $5.65 each in lots of 1-24 and in TO-100 package and 10-lead 1/4-inch flatpack (operating temperature -55°C to +125°C) for $17.93 (to 24).

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Circle 114 on reader service card

NEW SEMICONDUCTORS

LOW-VOLTAGE UNIJUNCTION

The 2N5431 is a Motorola unijunction transistor designed for operation on supply voltages as low as 4 volts. Made by improved construction techniques, this UJT has an emitter current leakage of only 10 nA, about 1/100th the leakage of some earlier types. Likewise, peak point leakage current is only 0.4 µA maximum at Vem of 25 V and 4.0 µA at 4 V. These two characteristics are critical for long-time-delay, low-leakage circuits.

Other outstanding characteristics are intrinsic standoff ratio (r) range of 0.72-0.80, base-to-base resistance Rbb range of 6,000 to 8,500 ohms. Maximum reverse emitter voltage (Vem) is 30 V, maximum emitter current is 50 mA rms, power dissipation is 300 mW and maximum emitter saturation voltage is 3V.

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NEW BOOKS


A compilation of service data for all G-E radios, phonographs, tape recorders and CB radios made in 1967-1969. Contains troubleshooting, alignment procedures, parts lists, pictures of each model, dial stringing diagrams, voltage and resistance readings, transistor substitution charts, exploded mechanical views of tape recorders and a new feature in this volume: bottom-view component layout drawings. A must for the efficient service shop.


This 46th (1969) Edition is printed on non-gloss paper for minimum glare and sharp, clear photographs. It has undergone considerable revisions in sections devoted to construction and theory and new material has been added to cover such subjects as dual-gate MOSFET's, solid-state product detectors, oscillators, i.f., rf, af and dc amplifiers. New construction charts as solid-state transceivers and transmitting and transmitting converters have been added.

For the past few years, each new edition of The Handbook has been revised with some new, particularly construction projects—deleted or greatly condensed to make room for the new. In this process, some illustrations used in the 1968 Edition have been dropped or rearranged without appropriate caution. As a result, many references to illustrations are completely meaningless. However, the most disturbing result of revisions in the 1969 Edition is the deletion of the 2.4 kW pep 3-1000Z ground-grid linear amplifier and its power supply from Chapter 6. There are no construction details or power supply schematics for the 3-400Z and 3-500Z linear amplifiers. The text refers the reader to the power supply for the 3-1000Z amplifier described later in the chapter. But the 3-1000Z amplifier was not included in the latest Edition. You'll have to go back to the 1968 Edition.

Even with its omissions and editorial "goofs", The Handbook is still the standard manual for radio communications, theory and construction techniques, and is equally useful to beginners, and advanced radio amateurs and professionals. W2PWWG

T-F-E

CANADIANS: Ordering is easy — we do the paperwork — try a small order. IBM COMPUTER SECTIONS IBM assembler listing with over 500 valuable parts. Incl. — Transistor Circuit, Heat Sink, Diode, Trans., 3$8.40, 100 for $10.00

100 SCREWS in 4/40ASST. ASSORTED WASHERS in 6/32, 8/32, 10/32, and 1/4" sizes. Incl. — Tube, $1; RCA 110° FLYBACK TRANSFORMER

110° TV DEEXC., $1.49

"COMBINATION SPECIAL" RCA 110° FLYBACK plus 110° DEFLECTION COIL, $1.95

60° TV DEFLECTION Yoke for all types TV's, $0.95

2-TV CIRCUIT BREAKERS, 4 amp. 2.95

110° COLOR YOKE, $1.05

90° COLOR YOKE, $1.05

TWIN COLOR CYTHER, $1.05

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$1.95 318 6LG7 12AT7 6H65 , $5.95

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Regular removable single & dual plug $1.95

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Hi-Fi Quality Complete $5.95 with stereo plug

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ASSORTED FOR POLARIZED TUBES

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5—AUDIO OUTPUT TRANS. FORM Bobbin for Trans Radios $1.95

5—PNP TRANSISTORS

Transistor general purpose, TO-3 case

MOTOROLA HEP KIT—INTEGRATED CIRCUITS INCLUDES —One 2N3914, One 502, One 705 Buffer, One 4-Input Gate. Two $2.95 $2.95

MOTOROLA EXPERIMENTER KIT KEX-2: 2—9Proj. Instruction Booklet, Kit, 2—Transistors : "This is using or $3.95 $3.95 "FIFTY" & Cross-reference Guide

100— TV TWIN LEAD-IN WIRE $2.00 300 ohm, surface heavy duty, clear

Circle 115 on reader service card

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IC COLOR PATTERN GENERATOR  (continued from page 51)
screw and nut. Mount the transformer last to keep the board light while mounting the other components.

Ground the crystal cases to the adjacent ground area.

Use No. 26 solid wire for the connections to S1-a and S1-b. Connections from S1-a to the integrated circuits should be made on the component side of the board directly onto the integrated circuit.

S1-a will have two leads, one to IC2-B-8 and the other to IC10-B-12. Bring ground and B+ to S1-b from any convenient point.

The output is taken from the two circles to the left of R23 to the output socket with a piece of 300-ohm twin lead.

Initial tests

Make sure there are no solder splashes shorting adjacent foil runs. Then, while monitoring the emitter of Q5 with a dc meter, apply power. The voltage should rise to about +2.9 in around 5 sec. If this voltage is obtained, observe the waveform at pin 5 of IC11 with a scope. You should see the waveform shown in Fig. 5 with the selector switch in position 6. If the observed signal is absent or greatly different, carefully check the jumpers, IC orientation and solder connections. Verify that B+ is on pin 11 of all ICs and on the arm of S1-b. A 189-kHz square wave should exist at pin 2 of IC12. The duty cycle should be adjusted to about 50% with R31.

Since some of the specified ca-

Fig. 5—Waveform at IC11-5 with the scope sweep at 15.75 kHz. Adjust R4 until T1 is 16% of H. Adjust R14 and/or R15 until T2 is 8% of H. Selector switch must be in Color Bar position.

Fig. 6—Waveform at IC9-a with the scope sweep set to 30 Hz. Adjust R17 and/or R16 until T3 of Fig. 6 is about 5% of V.

Fig. 7—Waveforms at IC12-7. (a) Waveform when R7 is correct value. (b) R7 too small reduces chroma level. (c) R7 too large also reduces chroma level.
Final tests

Tune a normally operating, well-converged color set to channel 3, 4 or 5, whichever operates in your area. Fine-tune the station carefully. Connect the set's antenna terminals to R23 with a piece of twin lead. With the pattern generator on the color bar position and the set's color control off, adjust I.1 until the edges of the vertical bars are sharp with just a little ringing noticeable. Turn the color control back to normal and adjust C4 until the color bars fall into sync and the third bar from the left is red.

Check the remaining patterns. Dot and vertical line width can be varied to taste with R13. Contrast can be varied with R20. Horizontal lines are one line high per field, but the interfaced pattern will produce a horizontal line two scanning lines high each frame. On some sets every other horizontal line will appear half the height of the remaining ones. Slight readjustment of the vertical hold control will make bars from all equal.

If a chroma amplitude control is desired, replace R11 and R12 with a 500-ohm linear pot. Its arm goes to C23.

If a clear raster would be more useful to you than the horizontal or vertical line pattern, connect S1-a-2 or S1-a-3 to B+ through a 620-ohm resistor instead of IC2-C8 or IC1-C8.

Drill the rear cover of the generator case for the ac cord and the output socket.

Mount the PC board on the rear cover using 3/8-inch plastic spacers and 4/40 screws, 3/8 inch long.

A hole on the front for the switch (and chroma pot if used) and two holes for the handle complete the project. The handle shown in the photo was obtained from the cabinet ware department of a discount store.

Total cost of the generator will be $45 to $50.

R-E

C8—56 pF
C9—300 pF
C10—0.0033 pF
C11—0.47 µF (Sprague HY-330)
C12, C13—3.3 pF
C14, C16, C17—10 pF, NPO (Sprague Q10)
C15—25 pF NPO (Sprague Q25)
C20—1000 pF, 15V, electrolytic, (Sprague T17-1163)
C21—200 pF, 6V, electrolytic, (Sprague TE 1102.5)
C22—140 pF, 6V, electrolytic, (Sprague TE 1102.5)
C23—470 pF
C24—0.02 pF

Semiconductor devices

D1, D2—1N34 or similar germanium diode
IC1—IC8—Motorola MC 890P
IC9, IC10—Motorola MC 824P
IC11, IC12—Motorola MC 889P
RECT—Full wave bridge, 25 PIV, .75 A
(Motorola MD4920-1)
Q1, Q2, Q3, Q4—2N8850 or similar
Q5—RCA 2N5034, 2N5035 or Motorola MJE 520
L1—1/4 turns, #20 solid wire, spaced 1/4 inch, tapped 1/2 turn from B+ end, 1/4 inch diameter.
T1—115 to 6.3 VAC filament transformer, 0.6A (Thordarson 21F21)
XTA1—185 KHz crystal, wire leads (order crystal style HC6/U directly from Texas Crystals, Fort Myers, Florida. $6.00)
XTA2—3.56379 MHz crystal, (Order from above source. Specify HC6/U, with wire leads, for color TV, $2.95)
Coil form for L1—J. W. Miller 4500-2 1/4 inch dia, 5/8 inch long, (Newark Electronics part 9F3362).
Cabinet—6 13/16 x 5 9/32 x 2 1/2 Allied part 42C7886
Cover—6 1/2 x 5, Allied part 42C7888
Output socket—Moyle 343 with mating plug 303

An etched, undrilled PC board may be ordered from Techniques Inc., 235 Jackson St., Englewood, N.J. 07631. The price is $3.00.

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As the circuit shows, all you need is a bell or buzzer and an inexpensive diode. When the lights are on, voltage is supplied to one side of the buzzer. When the door is opened, the courtesy-light switch closes and completes the circuit to ground so the buzzer sounds. The diode prevents reverse current from flowing through the dome light, buzzer and headlight to ground.—R. Kaacker

HOT-CHA SIS SERVICING PRECAUTIONS

Since the chassis of some receivers are connected directly to one side of the ac power line, the following precautions should be observed when working on this type equipment:

1. Use an isolation transformer in the power line between the receiver and the ac receptacle.
2. When the receiver must be operated directly from the ac line, the power plug must be inserted in the receptacle so the chassis is connected to the grounded side of the power line. Check with an ac voltmeter to see if a voltage potential exists between the chassis and power source ground. The meter should read zero. If a reading is obtained, reverse the line plug and recheck for a zero reading.
3. When replacing a chassis in the cabinet, always be certain that all protective devices are put back in place, such as: non-metallic control knobs, insulating fishpapers, adjustment or compartment covers, shields, isolation resistor-capacitor networks, etc. Before replacing the back cover, inspect inside the cabinet to be sure that no stray parts or tools have been left inside.
4. Before returning the set to the customer, you must be sure that no shock hazard exists. Plug the ac line cord directly into a 120-volt ac receptacle (do not use an isolation transformer for this test). Using two clip leads of sufficient length, connect a 1500-ohm, 10-watt resistor in series with an exposed metal cabinet part and a known earth ground such as a water pipe, conduit, or similar object. Use an ac voltmeter of 1000-ohms-per-volt or greater sensitivity to measure the voltage drop across the resistor. Move the resistor connection to each exposed metal part (antennas, handle bracket, metal cabinet, screw heads, control shafts, etc.) and measure the potential across the resistor at each new connection. Now, reverse the line plug and repeat each measurement.

Any reading of 30 volts or more is excessive and indicative of a potential shock hazard which must be corrected before returning the receiver to the owner.—RCA Television Service Data

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Using the components values suggested in the schematic, the generator frequency range will be from 100 Hz to approximate 1000 Hz. Any low-power pnp transistors such as the 2N190, 2N107, 2N188, etc. will perform well.

As shown in the schematic the 2-section 5-position selector switch is used so you can select other waveforms. (Fig. 2) generated by the multivibrator.

The waveform in Fig. 2-a is the negative-going sawtooth obtained when the selector switch is in position 1. Fig. 2-b is the positive-going sawtooth obtained with the switch in position 1 and the output leads reversed. Figs. 2-c, d and e are obtained with the selector at 2, 3 and 4, respectively. —Charles D. Rakes.
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(continued from page 88)

BROKEN TUNING SCREWS

When one side of the slotted screw breaks off, screw on a ¼-inch brass hex nut flush with top of screw, then flow in solder to anchor in place. Adjustment can then be made with a wrench or alignment tool.

Adjustments are more accurate and convenient by this method since it eliminates most of the play.—S. Clark

WIRING TIP

If you run into difficulty trying to put three or four wires in a single socket terminal lug just cut a slit in the lug and spread the opening apart. Place all wires inside of hole; squeeze the opening together again and solder.—S. Clark

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SOLDERING IRON TIPS

It doesn't take too much imagination to picture an average electronics technician working on a 'rusty' job, soldering one or several replacement parts in a set and "Oops," the soldering gun tip burns in half.

Such an incident is nothing more than a slightly time-consuming thing; hunting a new tip, unbolting the old one, bending the new tip ends to fit the gun, etc.—but then sometimes we're out of replacement tips, or can't find the ones we have.

To finish the soldering job right then, merely take pliers and give the two broken tip wires a couple of tight twists on the end, cut off the forward tip end and tin the protruding ends. Metal scale along the untinned portion of the copper wire will effectively prevent current overloading for the time being. Now you can smile as you finish the job.—Geo. D. Philpott

WEATHERPROOFING SPEAKERS

For weatherproofing speakers cones for outdoor use, we find that spraying them with "Scotchgard" is the best compound for the job.—Harry J. Miller

A TIP TO FILE

Corrosion can be easily cleaned from an auto radio antenna input socket, by first reaming out the grounding sleeve with an automobile distributor-cap cleaning tool (round wire brush). The center terminal can then be cleaned with a small round file. Both clean surfaces should then be coated with contact grease, to prevent further corrosion.—Jim Houseknecht

CARPET PADDING IN THE SHOP

Your local floor-covering dealer is the source of a very handy material to have around the shop. I am referring to waffle-type rubber floor padding. Remnants and small pieces are available for little or nothing.

Squares (about 15 to 20 inches) of this material on the workbench are ideal pads for easily scratched transistor radios. Furthermore, the small screws taken out of the chassis will not roll off the bench if you drop them. These small squares are also handy for cushioning picture tubes when removing or replacing them in the chassis. A larger piece is indispensible for laying on the floor when you have to turn over a TV cabinet to work on the under side of the chassis or to replace detachable legs. A piece on the floor of your truck or station wagon lets you lay the set on its side for easier handling.—John H. Larry

JANUARY 1970

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