Electronics World

FEBRUARY, 1971
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NEW COLOR-TV CIRCUITS FOR 1971

HOME TV PICTURES FROM A DISC

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VTRs— VIDEO TAPE RECORDER DIRECTORY -p. 32-LIST

Photomicrographs by
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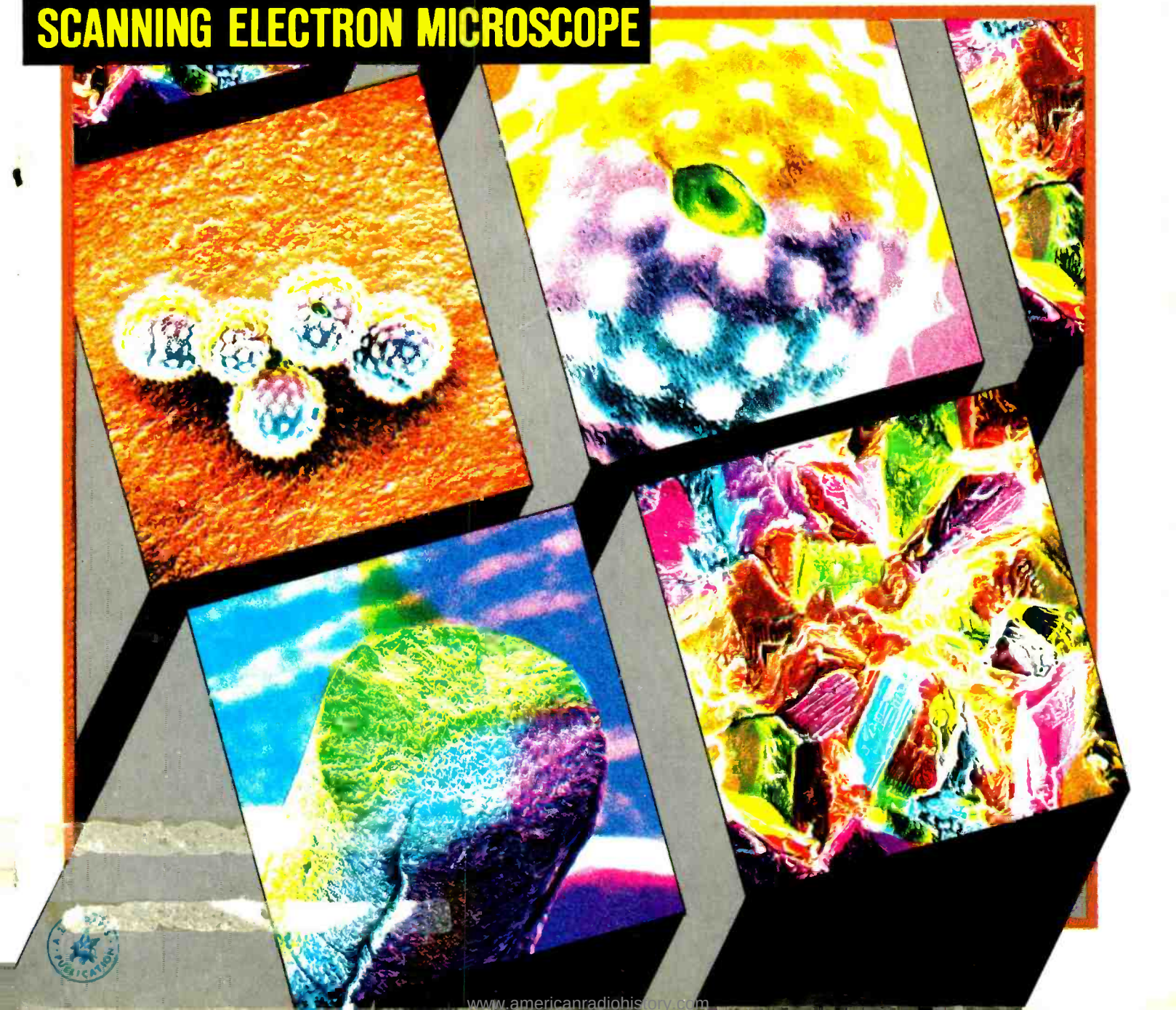

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WITH THE NEW HI-LO FIELD EFFECT MULTIMETERS

USES ONLY .08 VOLTS TO POWER OHMMETER TO PREVENT TRANSISTORS FROM CONDUCTING AND UPSETTING READINGS

Look at these extra features to see why the Hi-Lo meter belongs on your want list:

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- 9 DC voltage ranges from as low as .1 volts full scale to 1000 volts
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- 7 resistance ranges from 1000 ohms full scale to 1000 megohms
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- Automatic built-in battery test . . . never a worry about rundown batteries, just push the switches under the meter and read.
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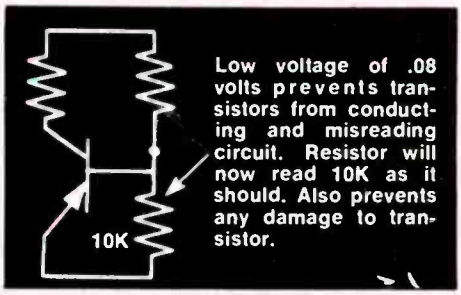
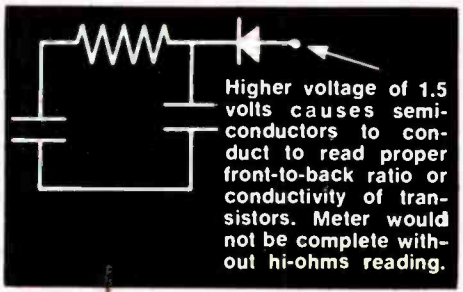


Low voltage of .08 volts prevents transistors from conducting and misreading circuit. Resistor will now read 10K as it should. Also prevents any damage to transistor.

Here is why you should have both Hi and Lo battery voltages for correct in-circuit resistance measurements in solid state circuits:



Higher voltage of 1.5 volts causes semiconductors to conduct to read proper front-to-back ratio or conductivity of transistors. Meter would not be complete without hi-ohms reading.

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CIRCLE NO. 123 ON READER SERVICE PAGE

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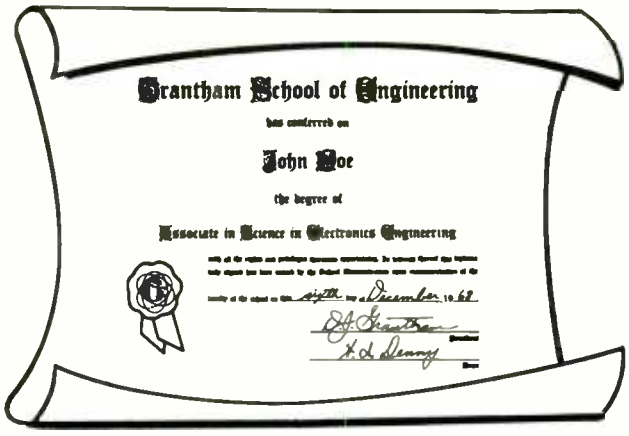

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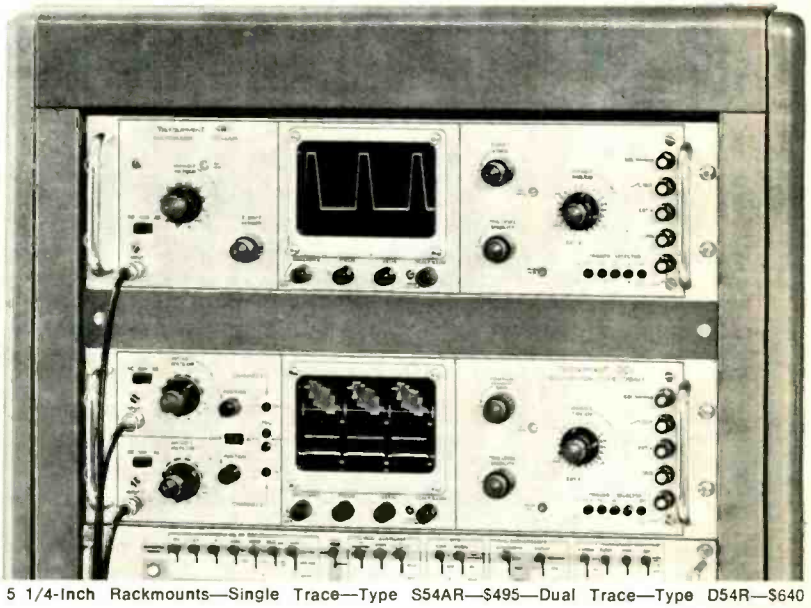

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TELEQUIPMENT

Electronics World

FEBRUARY 1971 VOL. 85, NO. 2

Contents

THIS MONTH'S COVER shows four photomicrographs taken for us with a scanning electron microscope. Normally the images are in black-and-white, but we have enhanced them by artificially adding color. The top pair show ragweed pollen at 1000X and 5000X magnification, while the bottom pair show stress corrosion fracture in titanium alloy wire at 100X and 2000X magnification. For further details see story on "Scanning Electron Microscopes" in this issue. Cover photomicrographs: Battelle Memorial Institute, Columbus, Ohio.

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February, 1971

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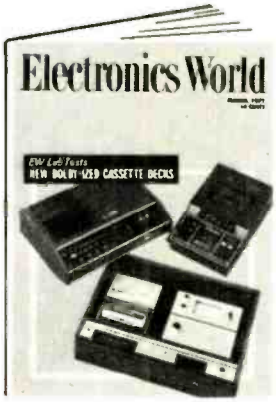

EW LAB TESTS "DOLBY-IZED" CASSETTE DECKS

Results of our laboratory measurements on three of the newest models show that whichever one you choose, the addition of Dolby circuits has made the cassette a true high-fidelity medium. The Advent Model 200, the Harman-Kardon CAD-5, and the Fisher RC-80 have been tested and evaluated by Julian Hirsch and you won't want to miss his comments on each of these units.

Color-TV for 1971 (Part 2)

The use of integrated circuits, varactors for tuning, and more solid-state high-voltage rectifiers characterize chassis in most companies' color-TV lines. Forest H. Belt discusses such circuits and features to be found in sets from fifteen manufacturers and tells how they work.

CATV Its Future Starts Now

Will wired cable TV take over from on-the-air TV? Trend-setting installations in New York City and Akron, Ohio may furnish clues of things to come. New techniques and sophisticated equipment are making CATV formidible competition for MATV and broadcast systems.

EW Lab Tests V.O.M.'s

Which v.o.m. should a service technician pick for his bench? What features does he need? Which instrument, among the hundreds on the market, will meet his requirements best? This useful guide, with performance specs, will make the job easier for every technician.

All these and many more interesting and informative articles will be yours in the March issue of ELECTRONICS WORLD . . . . . on sale February 18th

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EDITORIAL CONTRIBUTIONS must be accompanied by return postage and will be handled with reasonable care; however publisher assumes no responsibility for return or safety of art work, photographs, or manuscripts.

ELECTRONICS WORLD (February, 1971, Vol. 85, No. 2) Published monthly at One Park Avenue, New York, New York 10016, by Ziff-Davis Publishing Company—also the publishers of Airline Management and Marketing Including American Aviation, Boating, Business & Commercial Aviation, Car and Driver, Cycle, Flying, Modern Bride, Popular Electronics, Popular Photography, Skiing, Skiing Area News, Skiing Trade News, Stereo Review, and Travel Weekly. One year subscription rate for U.S., U.S. Possessions, and Canada, $7.00; all other countries, $8.00. Second Class postage paid at New York, N.Y. and at additional mailing offices. Authorized as second class mail by the Post Office Department, Ottawa, Canada and for payment of postage in cash.

Radio & Television news

By MURRAY SUNTAG/Associate Editor

Nailing Nation's No. 1 Killer

Thanks to electronics, even the staid old medical profession is now being brought into 20th century. New stethoscope-like device, called the Stethosonus, may make it necessary for us to re-adjust our mental image of a doctor. Incorporating latest advances in integrated circuitry, Stethosonus, unlike acoustical stethoscope, is capable of amplifying heart sounds in all frequency ranges. Device can be used with the Tavel-Andries Heart Sound Recorder and computer-prepared phonocardiograms to provide physician with a significantly improved working tool for diagnosing heart disease—nation's No. 1 killer. Recorder permits the permanent auditory recording of heart sounds on a cassette which serves as the input for computer-prepared phonocardiogram.

Stethosonus is approximately the same size and weight as a conventional stethoscope and fits easily into the physician's pocket. Selling for $105 ($119 with extra headset for dual listening), it was developed by *Computer Medical Science Corp.*, Houston, Texas in collaboration with Dr. Morton E. Tavel, Associate Professor of Medicine at Indiana University School of Medicine. Recorder may be purchased for $600 and cost to physician for each computer analysis is only $4.00.

Thanks for the Memories

According to *Frost & Sullivan, Inc.*, a defense and space market research organization, semiconductor computer memories accounting for about 3% of the $700 million memory market today will be a $3 billion market by 1980. An in-depth forecast of the digital computer memories market has been published, presenting advantages and disadvantages of the following present and future memory technologies: magnetic cores, magnetic disc files, magnetic tapes, magnetic drums, ferro-electric devices, magnetic flux rings and thick films, MOS circuits, woven braided wire, magnetic domains-bubbles, photographic storage, magnetic-optic storage, hybrid combinations, etc. For those interested, contact Joseph Levy, Industrial Studies Division, *Frost & Sullivan, Inc.*, 106 Fulton Street, New York, N.Y. 10038.

And, while we're on this subject, scientists at *General Electric* Research and Development Center, Schenectady, N.Y. invented a semiconductor circuit element that can store information on a silicon chip at densities of a million bits per square inch. Called a surface charge transistor, it contains three electrodes—two electrodes (source and receiver) separated by a narrow slit and a third electrode (transfer gate) that overlaps this slit. Only small amount of charge on transfer gate is required to control transfer of much larger charge across the surface charge transistor. Its inventors claim that its combination of high speed and small size (several hundred could fit on period ending this sentence) promises major increase in information storage capacity of semiconductor memories.

Electronic Personalities

Like father, like son—Robert W. Sarnoff, chairman and president of *RCA Corporation*, was awarded the 1971 Gold Medal of the Poor Richard Club—one of the oldest advertising and public relations clubs in the world. The award was presented to Mr. Sarnoff at the 65th annual banquet of the organization on January 16. The Gold Medal is a nationally recognized award for outstanding achievement in advertising, marketing, and communications. Other recipients of this coveted award have included: President Dwight D. Eisenhower, General Douglas MacArthur, J. Paul Austin, president of *Coca Cola Co.*, David Sarnoff, and Henry Ford II. . . Arthur C. Davis, vice-president of *Altec Lansing's* Audio Controls Division (Anaheim), and distinguished inventor and prominent industrialist, died on November 7, 1970. . . . Our congratulations to Dr. James H. Mulligan, Jr., Executive Secretary of the National Academy of Engineering, Washington, D.C. on his election, late last year, to the presidency of the Institute of Electrical and Electronics Engineers for 1971. Dr. Mulligan succeeds Dr. John V.N. Granger, Director and Consultant, *Granger Associates*, Palo Alto.

A Look into Distant Future

With the TV-phile in mind, *RCA* has developed an electronic home-entertainment center with five TV screens for simultaneous viewing. This unique home information center contains *RCA's* AccuColor TV set with the new 25-inch ultra-rectangular color picture tube, four 9-inch black-and-white monitors with electron-

ic tuners, a specially created acoustical pod with suspension speaker, and a combination digital clock and temperature gage—just about everything but the kitchen sink. With a unit like this in your home you would never be faced with the dilemma as to which TV program you should watch. You can watch one, two, or as many as four different programs at the same time. Three of the monitors can be programmed to receive signals from the major networks while the fourth continuously scans signals transmitted by local independent and educational stations. The large color tube will display the program that you select from one of the four monitors. A veritable working electronics laboratory, this instrument, with the addition of a network of portable TV cameras, a video playback unit, and with some modifications could also serve as security system or an all-encompassing entertainment device. Although instrument represents more of an engineering and design feat than a consumer item, it does give us some insight into things to come.

Spin-offs From Space Research

Brain sensor and radio transmitter system, previously used for space medical research with test pilots, now being used with computer in diagnosis and treatment of schizophrenic patients. NASA scientists, working with the Agnews State Hospital, San Jose, California, have used this system on mental patients undergoing clinical tests—with good preliminary results. Since system, which is installed in a headset, requires no exposed wiring (data is radioed), it presents no threat to disturbed patients who are apprehensive about shock therapy. Simplicity of system makes it possible to continuously monitor patients wearing headset consisting of a light wire clip fitted with two small electrodes. Electrodes sense brain wave through hair with no scalp preparations. As patients perform daily routines or are presented with different kinds of situations, data on their mental states is radioed by tiny battery-powered radio transmitter for computer analysis.

Laser beam, satellite, conversion of sea water to fresh water, microminiaturization, new structural materials—to name a few, are some of the technologies that have benefited from space research. Maybe insight into the human brain and behavior will be the next to benefit from such technology.

Taking Up the Slack

One possible answer to the problem of rising unemployment brought on by cutbacks in the aerospace industry, is channeling the engineering know-how from the depressed industries to one that will become one of America's major national concerns through the 1970's—transportation. Although certainly not as glamorous an issue as landing a man on the moon, the problems—as we all know too well—are astronomical. Transportation in this country is in a sorry state and it will take the aerospace engineering brains, systems expertise, and managerial genius that helped us reach the moon to disentangle us from the traffic jams that are literally strangling the country. Although Secretary of Transportation Volpe has given all engineers affected by the layoffs a standing invitation to join him in creating a true transportation system for this country, it will take more than lip-service. The Federal government must make the first move. Money must be made available to make Mr. Volpe's invitation good.

Bits and Pieces

As we go to press, meetings between NEA and NATESA augur well for a possible merger. Impetus for unification seems to be the advent of ServiceAmerica. During a NEA board meeting in Atlanta on October 8-10, a resolution was passed directing the staff of NEA and a special committee to explore all means of forming one national association. We feel that one strong organization of this type will be beneficial for all. . . Although there has been fanfare about cassette TV for the home in 1971, Lloyd Singer, vice-president of *Motorola Systems, Inc.*, has predicted that there will be no meaningful impact on the consumer until 1973 at the earliest. Singer said, "To tap the potential of the consumer market the cassette-TV industry must take fresh programming approaches, create a demand and develop a sense of the importance of the message and a clear-cut understanding of the role of the new medium in presenting information." That seems to make a great deal of sense to us. . . . For those looking for experience in integrated-circuit technology, *State of the Art, Inc.* is presenting IC seminars at the firm's State College, Pa. headquarters. Five-day seminars on the "Fundamentals of Monolithic Integrated Circuit Technology" (March 8-12) and the "Fundamentals of Thick Film Hybrid Microcircuit Technology" (Feb. 22-26) are scheduled. Tuition is $500. And for those in management who want a good introduction to the IC technology and business, another seminar, "Integrated Circuits—a Management Viewpoint," will be held on March 17-18. Tuition is $250. For further information, contact Donald W. Hamer, *State of the Art, Inc.*, 1315 South Allen Street, State College, Pa. 16801 (814-237-6583). . . . EIA's Marketing Services Department reports that in October 1970 distributor sales to dealers of monochrome and color-TV sets have started to move upward again after a long period of stagnation. While the figures still aren't impressive, the turnaround is heartening to those of us in the industry. Portable and table-model phonos did well too. ▲

Electronics World

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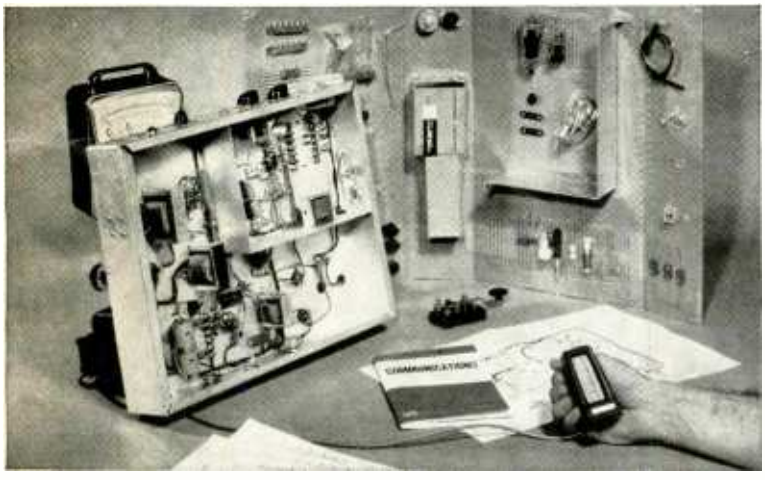

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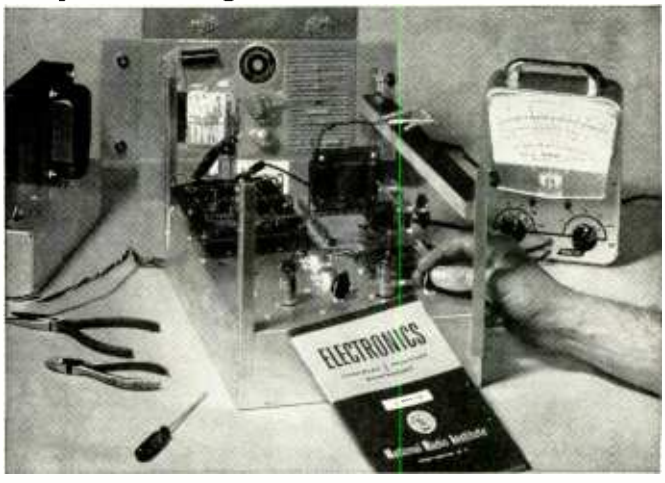

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HI-FI PRODUCT REPORT

EW LAB TESTED

by Hirsch-Houck Labs

Kenwood KL-5060 Speaker System
Sharpe Model 7 Stereo Phones

Kenwood KL-5060 Speaker System

For copy of manufacturer's brochure, circle No. 1 on Reader Service Page.

THE *Kenwood* name now appears on a new loudspeaker system, the KL-5060, complementing its broad line of receivers, tuners, and amplifiers. Until recently, few Japanese component speaker systems have reached the American market, so that we were especially interested in evaluating this speaker.

The KL-5060 is a compact floor-standing speaker, measuring 25½" high by 15" wide by 11¾" deep, and weighing in at 42 pounds. We have seen speakers of greater weight and comparable size offered as "bookshelf" systems, and this speaker is certainly capable of being installed that way, but we found it attractive enough to rate a place on the floor. The front is protected by a rugged and handsome metal grille.

This is a three-way system, with an 8-ohm nominal impedance. The woofer is nominally 12" in diameter (actual cone diameter is 10½") and operates in a ported enclosure. The 2½"-diameter circular port may be ducted internally, but we could not verify this because of the opaque cloth cap over its opening. At 600 Hz there is a crossover to a 6½" cone mid-range driver (actual cone diameter is 5½"), which operates up to 6 kHz. The high frequencies are handled by a pair of horn-loaded tweeters, whose cast metal horns have a mouth diameter of 2". In the rear of the cabinet are separate level controls for the mid-range and high-frequency speakers.

Following our usual practice, we auditioned the speaker before performing any tests. An initial impression of a speaker often provides guidance in identifying its strong and weak points. We set the speaker level adjustments to their indicated normal positions (each is calibrated from +3 to −12 dB, and can completely shut off the controlled driver).

The sound quality was strikingly smooth and easy, and it was obvious at first hearing that this was a better-than-ordinary speaker. The bass was somewhat heavy—not "tubby," but unmistakably noticeable when switching from other speakers with good but unaccentuated bass response.

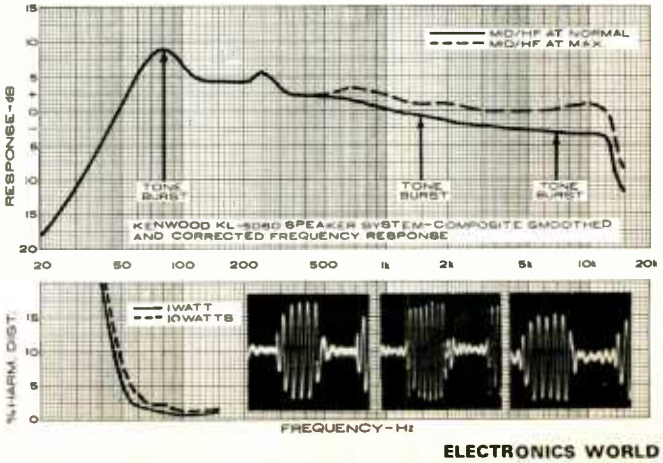
The frequency response curve was obtained by averaging the outputs of eight microphones, between 300 Hz and 15 kHz, correcting the higher frequencies for the known microphone response and smoothing minor irregularities (less than 2 dB) which are inherent in a "live-room" measurement. Below 300 Hz, the speaker's output was measured relative to that of a calibrated reference speaker, yielding a bass response curve equivalent to free-field measurements and essentially independent of the room characteristics. Joining the two curves produces a realistic indication of the over-all speaker output in a home environment.

A number of supplementary measurements were made to determine the effects of the mid-range and high-frequency level controls, the polar response of the system, its low-frequency distortion, and its impedance over the full frequency range.

The final frequency-response curves, with both level controls set to "Normal," was unusually smooth and free from holes or peaks. However, it sloped downward with frequency so that the 10-kHz level was 8 to 10 dB below the maximum low-frequency output. By setting both level controls to maximum, the over-all response was an excellent ±3 dB from 100 Hz to 12 kHz. The bass output rose about 3 dB at 80 Hz, falling to about 3 dB below the mid-range level at 50 Hz. Apparently the 80-Hz response peak, combined with the relatively strong output in the entire 50- to 300-Hz region, gave the speaker its slightly heavy sound.

The polar response of the speaker was good, attesting to the wide dispersion of its shallow-cone mid-range driver and high-frequency horns. Tone-burst response was good throughout the speaker's frequency range. Its impedance was exceptionally uniform, between 6.5 ohms and 10 ohms from 20 Hz to 20 kHz, except for the low-frequency resonance at 65 Hz, where it reached 20 ohms. Low-frequency distortion was low down to 50 Hz, where it reached 5% at 1-watt input. Even at 10-watts input, the distortion curve was quite similar, with the 5% level reached at 55 Hz.

The KL-5060 is a rather efficient speaker by contemporary standards. It is 5- to 8-dB more efficient than typical acoustic-suspension speakers we have tested. This proved advantageous when driving it from some good, but low-powered, receivers in the 15- to 20-watt-per-channel class.



Normally such receivers are underpowered for driving acoustic-suspension speakers, but are easily equal to the task of driving the KL-5060.

The most revealing test was the "live *vs* recorded" music reproduction comparison, using a specially made tape and reference speaker. (This test was fully described in STEREO REVIEW for August, 1970.) With both speaker level controls set to maximum, the reproduction of middle and high frequencies was outstanding, ranking among the top loudspeakers that we have tested.

To summarize, the speaker has a very smooth, widely dispersed and extended frequency response, a slightly exaggerated bass output in the 50- to 100-Hz region, relatively high efficiency, and good transient response. We found it eminently listenable with all types of program material, and styled as attractively as seems possible with a simple box configuration.

The *Kenwood* KL-5060 sells for $139.95 each. ▲

Sharpe Model 7 Stereo Phones

For copy of manufacturer's brochure, circle No. 2 on Reader Service Page.

ALTHOUGH the frequency response and distortion of headphones can be measured using standardized "artificial ears" to simulate the coupling of the phones to the listener's ears, we prefer to rely on a subjective evaluation.

Enjoyable stereo listening through headphones requires a combination of good electro-acoustic performance and a physical design compatible with comfortable wearing over extended periods. With stereo phones selling from less than $10 to over $100, it is reasonable to expect considerable variations among them, both in physical and audible characteristics.

A new stereo headphone from a well-known maker of quality headsets is the *Sharpe* Model 7. Although priced quite moderately, it delivers a relatively smooth response over the full audio range, is ruggedly constructed, and is attractively styled. One feature which we especially appreciated is the long coiled cord, extendable from about 3 feet to over 10 feet. (We measured its maximum extension as about 14 feet.) This allows the wearer considerable freedom of movement, without the annoyance of tangled cords. The cord is molded into one of the earpieces at one end and is fitted with a molded stereo phone plug at the other end.

The Model 7 phones weigh about 10 ounces. They have a flat, adjustable headband and liquid-filled ear cushions, and are available in bronze or green. Their construction makes extensive use of light, high-impact plastics. They fit comfortably, although snugly, and external noises are effectively excluded by the ear cushions. Unlike many stereo phones, these are physically unobtrusive, protruding only slightly from the head.

Our laboratory measurements were limited to plotting an impedance curve. The rated impedance of the phones is 8 to 16 ohms; although we measured it at about 20 to 25 ohms. There was very little variation in impedance over the full frequency range and we found no trace of resonance.

Subjectively, we sensed an increased output in the 100 Hz to 300 Hz region, which imparted a slightly heavy quality to male voices. (This effect is very common with loudspeakers as well.) The highs were clean and smooth and seemed comparable to the high-end response of some good speakers to which we compared the phones. We were most impressed with their low-end response, which indeed went all the way to 20 Hz as claimed, although it seemed to drop off noticeably below 30 Hz. At that frequency, however, we felt a solid impact, with low distortion, that only a few speakers can match.

Over-all, we found the sound quality of the phones most pleasing with some bass cut and treble boost from the amplifier controls. This was not an attempt to bolster missing frequency regions but to restore a better over-all balance. We played the phones at very high levels and found it difficult to induce audible distortion at any level which our ears could tolerate.

The *Sharpe* Model 7 stereo headphones are priced at $19.95. We consider them to be a good value for the price and comparable to many more expensive phones we have used. ▲

The Great E-V Feedback Loop Contest

Enter free at any of these participating Electro-Voice soundrooms.

ALABAMA

GADSEN—Southeastern Radio, 304 S. Fourth
HUNTSVILLE—Electronic Center, 2322 S. Parkway
MONTGOMERY—Southeastern Radio, 635 Jefferson

ALASKA

ANCHORAGE—Anchorage Radio, 529 C St.
JUNEAU—Alaska Radio, 1000 Harbor Way

ARKANSAS

LITTLE ROCK—Lavender Electronics, 1122 Center
Southern Electronics, 1417 Main

CALIFORNIA

ANAHEIM—Henry Radio, 931 N. Euclid
HOLLYWOOD—Magnetic TVI, 716 N. LaBrea
LONG BEACH—Scott Audio, 266 Alamitos
LOS ANGELES—Henry Radio, 11240 W. Olympic
Shelley's Audio, 721 W. 9th
RIDGECREST—Kunz Photo & HiFi, 237 Balsam
SAN DIEGO—Breier Sound, 3789 Park
SAN FRANCISCO—Olson Electronics, 169 Eleventh
SAN JOSE—Century Music, 448 S. Winchester
Quement Electronics, 1000 S. Bascom
SAN RAFAEL—Catania Sound, 857 Fourth
SANTA BARBARA—Audiovision Co., 3951 State
SANTA ROSA—Fred Plant Electronics, 423 Fourth
WATSONVILLE—Jennings Electronic Center,
120 Manfre
WHITTIER—Oxbow Electronics, 15914 E. Whittier
YUBA CITY—Wyville, 710 Plumas

COLORADO

AURORA—Alpha-Tronics, 14251 E. Colfax
J & B Electronics, 10200 E. Colfax
BOULDER—Colorado Electronics, 1031 Walnut
DENVER—C. W. Electronic Sales, 1237 16th
Electronic Laboratory, 562 S. Broadway

CONNECTICUT

DANBURY—Carston Studios, 146 Old Brookfield, N.

DELAWARE

NEWARK—Delaware Music, 132 Main
WILMINGTON—RESCO, 3601 N. Market

DISTRICT OF COLUMBIA

Glen's Audio, 1206 "G" St., N.W.

FLORIDA

CLEARWATER—Towers Distributing,
2119 Gulf to Bay Blvd.
FORT LAUDERDALE—Ridge Stereo,
3024 E. Commercial
ORLANDO—Olson Electronics, 1021 Colonial
WEST PALM BEACH—Stereo Omnibus,
754 N. Lake Blvd.

GEORGIA

ALBANY—Southeastern Radio, 206 S. Monroe
ATHENS—Southeastern Radio, 393 N. Finley
HAPEVILLE—Southeastern Radio, 565 N. Central
MACON—Southeastern Radio, 866 Second

ILLINOIS

AURORA—Cook's HiFi, 31 S. Broadway
CHAMPAIGN—Bandy's TV, 711 S. Sixth
CHICAGO—Gill Custom House, 1043 E. 95th
Musicraft, 1855 N. Halsted
Musicraft, 2035 W. 95th
Musicraft, 48 E. Oak
Olson Electronics, 4101 Milwaukee
Olson Electronics, 2641 W. 95th
Olson Electronics, 123 N. Western
GALESBURG—J.L.Black, Fremont & Henderson
Lindstroms Furniture, 224 E. Main
HIGHLAND PARK—Columbia Hi Fi, 1805 St.Johns
MOUNT PROSPECT—Randhurst Music,
Randhurst Shopping Center
MORTON GROVE—Musicraft, 5700 W. Dempster
OAK PARK—Musicraft, 7045 W. North
PEKIN—Cohen Furniture, 11th & Margaret
ROCK ISLAND—Heriford's, 4708 11th
STERLING—TCR Distributors, 210 Second

INDIANA

PLYMOUTH—Shemberger Music, 203 E. Garro
SOUTH BEND—Radio Distributing, 1212 High

IOWA

BURLINGTON—TCR Distributors, 515 S. Main
DAVENPORT—TCR Distributors, 1205 E. River
DUBUQUE—Miller Radio, 1599 Central
JEWELL—Wing TV
MT. PLEASANT—Van's TV
NAQUOKETA—Yeager TV
PELLA—Wander's TV
PERRY—Don's TV, 302 Willis

IOWA (Cont.)

WATERLOO—Farnsworth Electronics,
201—205 E. Mullan

KANSAS

MISSION—Asper Electronics, 5834 Johnson
OVERLAND PARK—Asper Electronics,
8907 W. 95th

LOUISIANA

METAIRIE—Pelican Electronic, 3321 Division
Sterling Electronics, 5029 Veterans Hwy.
NEW ORLEANS—Pelican Electronic, 2231 Banks

MARYLAND

BALTIMORE—Stansbury Stereo, 1709 Poplar Place
JOPPATOWNE—Stansbury Stereo, 1018 Joppa Farm

MASSACHUSETTS

BOSTON—Music Room/Government Center Camera,
Two Center Plaza
CHICOPEE—Valley Sound, 20 First Ave.
CONCORD—Audio Consultants, 27 Thoreau
NORTHAMPTON—Melody Corner, 186 Main
PITTSFIELD—Seiden Sound-Lafayette,
42 Summers
RANDOLPH—Boston Audio, 2 Teed Dr.
SPRINGFIELD—Soundco, 2065 Roosevelt
WINCHESTER—Sound Specialists, 7 Waterfield
WORCESTER—Tape & Players, 399 Park

MICHIGAN

ADRIAN—Aldrich Music, 142 S. Main
ALLEN PARK—Olson Electronics, 15847 Southfield
ANN ARBOR—Home Appliance Mart,
2019 W. Stadium
BATTLE CREEK—Kipps Professional Products,
552 W. Columbia
DEARBORN—Almas Hi Fi, 15031 Michigan
DETROIT—High Fidelity Workshop,
16400 W. Seven Mile Rd.
KLA Laboratories, 7375 Woodward
Olson Electronics, 15620 Grand River
Olson Electronics, 14243 Gratiot
Pecar Electronics, 11201 Morang
Stereoland, 17131 W. McNichols
GRAND RAPIDS—Audio Distributors,
2342 S. Division
Electronic Sound, 2249 S. Division
GROSSE POINTE WOODS—Stereoland, 20746 Mack
LIVONIA—Stereoland, 33111 Plymouth
ROCHESTER—Stereoland, 139 S. Main
SAGINAW—Jack Gridley Music, 4612 State
SOUTHGATE—Stereoland, 13430 Northline
WESTLAND—Olson Electronics, 200 N. Wayne

MISSISSIPPI

HATTIESBURG—N & H Electronics, 402 E. Pine
JACKSON—Sound & Communications, 5466 N. State
PASCAGOULA—May Electronics, 605 Ingalls

MISSOURI

INDEPENDENCE—Asper Electronics,
509 E. 24 Hwy.

NEBRASKA

GRAND ISLAND—Lumbard Leschinsky, 107 E. 3rd
NORFOLK—Behmer Music

NEVADA

RENO—Sierra Custom Sound, 605 S. Wells

NEW JERSEY

CAMDEN—RESCO, 211 Market
NORTHFIELD—Rainbow Electronics, 318 Tilton
PENNSAUKEN—Lafayette Radio, 5057 Route 38

NEW YORK

ALBANY—Greylock Electronics, 65 Central
Seiden Sound/Lafayette, 79 Central
BRONX—Corner Distributors, 1C W. 181st
BUFFALO—Purchase Radio, 747 Main
COLONIE—Seiden Sound/Lafayette,
Korvette Plaza
GLENS FALLS—Seiden Sound/Lafayette
707 Upper Glen
ITHACA—Dryden Radio/Lafayette
1300 Dryden
KINGSTON—Greylock Electronics, 763 Albany
NEW YORK—Downtown Audio, 17 Warren
Sonocraft, 29 W. 36th
POUGHKEEPSIE—Greylock Electronics, 5 Parker
SCHENECTADY—Seiden Sound/Lafayette
141 Erie
SYRACUSE—Gordon Electronics,
2739 Erie Blvd., E.
Gordon Electronics, Western Lights Plaza

NEW YORK (Cont.)

TONAWANDA—Purchase Radio, 1230 Niagara Falls
WEST SENECA—Purchase Radio, Southgate Plaza

NORTH CAROLINA

ASHEVILLE—Bradley's HiFi, 826 Hendersonville
CHARLOTTE—House of Sound & Such,
5935 Pineville
RALEIGH—Stephenson Music, 101 W. Peace

OHIO

AKRON—Olson Electronics, 69 W. State
CLEVELAND—Olson Electronics,
21850 Center Ridge
Olson Electronics, 2020 Euclid
Olson Electronics, 6153 Mayfield
Olson Electronics, 6813 Pearl
Pioneer Standard, 5403 Prospect
Warren Radio, 5842 Ridge
COLUMBUS—Jimmy Rea's, 540 W. Broad
DOVER—TV Specialties, 446 E. 4th
FINDLAY—Fellers Electronics, 310 N. Main
PARMA—Winteradio, 5373 Ridge
SPRINGFIELD—Gene Tavenner, 33 E. Harding
TOLEDO—Audio Center, 1546 Alexis

OKLAHOMA

OKLAHOMA CITY—Sterling Electronics,
5611 S. Western
Sterling Electronics, 4327 N.W. 23rd

OREGON

PORTLAND—Electronic Wholesale Mart,
631 N.E. Grand

PENNSYLVANIA

BETHLEHEM—Bitronics, 4th & W. Broad
ERIE—House of Records, 362 W. Eighth
LANCASTER—George D. Barbey, 622 Columbia
LEBANON—George D. Barbey, 821 Quentin
PHILADELPHIA—A-C Radio, 1539 W. Passyunk
Penn Electronics, 5503 Frankford
RESCO, 7th & Arch
RESCO, 5930 Market
RESCO, 6587 Roosevelt
PITTSBURGH—Olson Electronics,
3405 Saw Mill Run
READING—George D. Barbey, 333 N. 4th
SWARTHMORE—Hi Fi Studio, 8 Park
WILLOW GROVE—RESCO, 29 York
YORK—Rosen Electronics, 215 S. George

RHODE ISLAND

PROVIDENCE—East Side Sound Studio,
95 Governor
WOONSOCKET—Sound Track-Auclair's,
566 Cass

SOUTH CAROLINA

CHARLESTON—Radio Labs, 475-477 E. Bay
COLUMBIA—Dixie Radio, 1900 Barnwell
Southeastern Radio, 1606 Gregg

TENNESSEE

MEMPHIS—Modern Music, 3145 Poplar
NASHVILLE—Electra Distributing, 1914 W. End

TEXAS

DALLAS—Crabtree's Electronics, 4428 Lemmon
Crabtree's Electronics,
3510 Marvin D. Love Fwy.
Crabtree's Electronics, 11430 N. Central Exp.
Crabtree's Electronics, 2608 Ross
FT. WORTH—Crabtree's Electronics, 2939 W. 7th
HOUSTON—Kustom-Tronics, 8383 "B" Westview
Kustom-Tronics, 8236 Long Point
Sterling Electronics, 3118 Smith
IRVING—Crabtree's Electronics,
254 W. Carpenter Fwy.
LAREDO—Medex International, 1217 Lincoln
McALLEN—McAllen Radio, 413 S. Broadway
SAN ANTONIO—Sterling Electronics,
4600 San Pedro

UTAH

SALT LAKE CITY—O'Laughlins Radio Supply,
113 E. Third, So.

VIRGINIA

ARLINGTON—Audio Associates, 3123 Washington

WASHINGTON

SPOKANE—Don's Stereo Center, E. 510 Francis

WISCONSIN

MILWAUKEE—Olson Electronics,
423 W. Michigan
Olson Electronics, 5830 W. Fond du Lac

ANNOUNCING!

The Great E-V Feedback Loop Contest

...in which there are a modest number of winners, inevitably a few losers, and a great deal of inner satisfaction.

Feedback. We believe in it. And we have utter faith in how it works.

That's why we dare to construct the Ultimate Feedback Loop: from Buchanan, Michigan to your home and back. It's on behalf of what we modestly proclaim is the most exciting design advance in any compact system: Motional Feedback.

What we ask of you is simple: visit any E-V showroom. Listen to the new Landmark 100 system (even if you aren't now shopping for a compact). Then tell us what you heard, what you think, what your reaction was. In short, provide us with direct feedback from your mind to ours.

Especially note the contribution made by our Servo-Linear* motional feedback circuits. Unique components that sense and measure actual cone motion — continuously comparing it and correcting it to agree perfectly with the original signal.

But don't listen to just the Landmark 100. Compare it. With anything. Components. Compacts. Whatever. Any price, any style. Be critical if you like. Or laudatory. But above all be honest.

Your reward? For most of you, only the satisfaction that you have made a direct, meaningful contribution to the state of the art. And to five of you — those we judge to have submitted the most provocative, germane, succinct commentary (be it pro or con) — we will award your choice of $399.95 worth of any E-V equipment (peculiarly enough, the exact price of a Landmark 100)!

For serious contestants, some background data on the Landmark 100 is in order. So we urge you to write for our modestly bombastic brochure on the subject. (Write direct; if you use the reader service number in this magazine it may take too much time.) While the brochure and the review reprints we send you might bias the feedback, we're willing to take our chances.

THE FINE PRINT:

All entries must be received by March 31, 1971 and the contest is void where prohibited. And of course E-V employees, representatives, dealers and their employees, competitors and their lackeys, our advertising agency and all their immediate relatives are not eligible. Neatness counts a little, but it's the thought that really matters. No entries will be returned, and all become the property of Electro-Voice, Inc., to do with as we please. Members of the E-V sales and engineering staff will be the sole judges. A list of winners will be provided to all who enclose a self-addressed, stamped envelope. We can only accept entries submitted on an official entry blank, validated by a participating dealer. And just one entry per person, please.

If you wish, you may send for our brochure. It has large color pictures to help you find the Landmark 100 in the store. We'll also send you a list of participating dealers, an entry blank, and the latest reviews. Or go directly to one of the dealers listed opposite. They have entry blanks, and all the rest, plus one of our little jewels on display. Either way, start soon. Time is short. *E-V Trade Mark

CIRCLE NO. 114 ON READER SERVICE PAGE

Electro-Voice ELECTRO-VOICE, INC.

Dept. 214N, 629 Cecil St., Buchanan, Michigan 49107

Please send me literature on the Landmark 100, a list of participating dealers, all recent reviews, and my free entry blank for the Great E-V Feedback Loop Contest. Please be prompt.

Name_____

Address_____

City_____ State_____ Zip_____

LETTERS

HOME STUDY OF ELECTRONICS

To the Editors:

I was most impressed by the article "Can You Learn Electronics by Home Study?" in the September issue. I did, however, feel slighted. It would have been nice to have seen the *Center for Technical Development* with its Digital Design Program for technicians and engineers listed among the schools in the table on page 35.

EUGENE A. PRESTA, Pres.
Center for Technical Development
Box 103
Louisville, Ohio 44641

* * *

TV X-RAY MONITOR

To the Editors:

In your writeup on the *Victoreen* Model 499 "Vic-Chek" (November Test Equipment Product Report), you mentioned your disappointment that the instrument was calibrated in counts per minute rather than milliroentgens per hour as recommended by HEW. The reason that this or any other meter that uses a Geiger-tube detector cannot be calibrated directly in mR/hr is because this type of detector depends on the particular energy of the x-radiation. In the case of a color-TV receiver, it has been found that the maximum x-ray output under typical operating conditions has an energy level of about 12 keV (thousand electron volts) from a 6BK4 shunt regulator tube, about 23 keV from a picture tube, and about 26 keV from a 3A3 high-voltage rectifier.

With all these different energy levels of x-radiation, one would have to use as a detector an ion chamber with rather complicated circuitry. The *Victoreen* Model 440 RF/C is such an instrument which has been adopted by the EIA for color-TV measurements. This instrument, however, costs more than ten times what the Model 499 sells for.

RICHARD DANKMAN
Pittsburgh, Penna.

Reader Dankman is quite correct. Since reporting on the Model 499, we have received additional technical details on the meter. These details point out that the full-scale reading of the Model 499 corresponds to about 0.05 mR/hr at 15 keV, 0.03 mR/hr at 20 keV, and 0.016 mR/hr at 25 keV. Obviously, the instrument is more than sensitive enough for the function intended. The manufacturer of the meter recommends that if a survey with the Model 499 produces no readings above mid-scale, one can be sure the set is well below the present stipulated tolerance level. If readings are obtained in the upper half of the scale, the set is probably still safe but further checks should be made of the h.v. adjustment and that the proper h.v. regulator and rectifiers are in use. Accurate tests should then be made with an instrument such as Victoreen *Model 440* RF/C.—Editors

* * *

C.E.T. TEST, SECTION #9

To the Editors:

I take exception to your answer to question 6 of C.E.T Test, Section #9. In your November issue you list (*b*) as the correct answer. The test question for (*b*) states: "a.g.c. control has less effect and TP II voltage becomes less negative,"—and your "correct answer" says for (*b*): "Without the bucking plus voltage from *R*158 total a.g.c. at TP II would be slightly lower." This is a contradiction since the "bucking" plus voltage's absence would tend to make the a.g.c. line higher (more negative) since it is initially a negative voltage. This higher negative voltage will be particularly obvious on the tuner a.g.c. line, resulting in a too-high negative a.g.c. voltage supplied to the r.f. amplifier grid. This causes excessive snow at all above medium-signal levels. The primary purpose of *R*158 is to serve as a "clamp" for the tuner a.g.c. line. The correct answer to question 6 is (*c*).

DON ALBERT
Stevens Point, Wis.

We agree with Reader Albert and we're sorry for the error.—Editors

* * *

REFLECTIVE HI-FI SPEAKERS

To the Editors:

The two recent articles (August and September issues) concerning hi-fi listening by direct *vs* reflective methods ("Is Omnidirectionality Desirable in a Loudspeaker?" and "Direct *vs* Reverberent Sound for Stereo Speakers") are certainly of wide general interest. However, if the listener is keenly interested in hearing playback as closely as possible to the characteristics in which it was recorded, there can be no substi-

tute for the best setup of direct sound radiation even to the point of listening *via* headphones or in an anechoic chamber or in the open air. However, if one wishes to listen to sound with more augmented harmonics without resort to reverberation devices, the average auditor may prefer reproduction from reflective surfaces. The latter has been the observation of this writer from experience dating back to laboratory work with *GE* immediately following development of the first cone-type dynamic speaker (Rice-Kellog in 1925).

Listening to complex sound reflections off wall surfaces yields far less distortion than listening to the same sound through reflex-type speakers, due to the wider dispersion of phase-shift characteristics in the former method. It appears almost ironical that hi-fi buffs should be so critical of the distortion in hi-fi amplifiers and then connect them to reflex-type speakers. Sales information usually reveals standard-performance sound-pressure data as generated by pure sine-wave drive over the musical spectrum. But, musical listening is not to single or simple sine-wave sounds, rather to very complex harmonic waveforms. In such cases, a reflex-type speaker may radiate as much as 50% distortion and yet "sound good."

FRANK J. BURRIS
Yucaipa, Calif.

It is true that some observers have measured high distortion from speakers, particularly at low frequencies and even with pure sine waves applied. Much of this occurs at such low output levels and at such low frequencies that most listeners do not object to it. With complex waves, the measurement becomes more difficult. Even here, some of the distortion is phase distortion to which the ear is not particularly sensitive, provided the sound does not contain much transient information. —Editors

* * *

COMPUTER MEMORIES

To the Editors:

With reference to my article "Computer Storage & Memory Devices" in the October, 1970 issue, while I do not question the ability of a programmer to create a program requiring 10^{14} bits of storage, I believe the typical program would likely be closer to 10^{4} bits of storage. This typographical error in the original manuscript appears in the sixth paragraph of the article.

A second error which was missed in my review is in the last sentence of the third paragraph of point 6, page 38. The word "limited" should have been "unlimited."

CARYL A. THORN
IBM Systems Dev. Div.
Poughkeepsie, N.Y. ▲

How to become a "Non-Degree Engineer"

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.

THE ELECTRONICS BOOM has created a new breed of professional man—the non-degree engineer. Depending on the branch of electronics he's in, he may "ride herd" over a flock of computers, run a powerful TV transmitter, supervise a service or maintenance department, or work side by side with distinguished scientists on a new discovery.

But you do need to know more than soldering connections, testing circuits and replacing components. You need to really know the fundamentals of electronics.

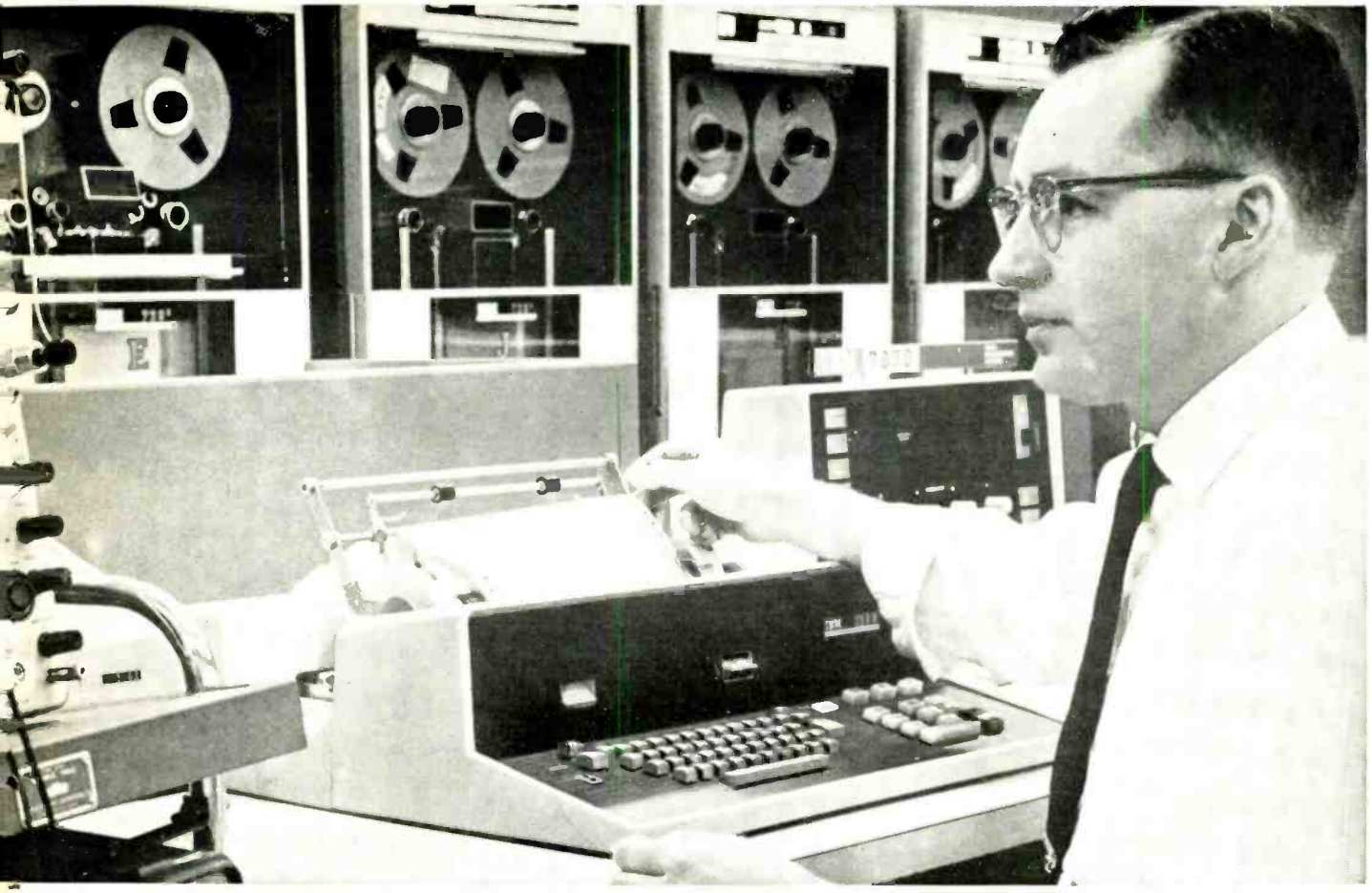
How can you pick up this necessary knowledge? Many of today's non-degree engineers learned their electronics at home. In fact, some authorities feel that a home study course is the *best* way. *Popular Electronics* said:

"By its very nature, home study develops your ability to analyze and extract information as well as to strengthen your sense of responsibility and initiative."

Cleveland Method Makes It Easy

If you do decide to advance your career through home study, it's best to pick a school that *specializes* in the home study method. Electronics is complicated enough without trying to learn it from texts and lessons that were designed for the classroom instead of the home.

Cleveland Institute of Electronics concentrates on home study exclusively. Over the last 30 years it has developed tech-



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.

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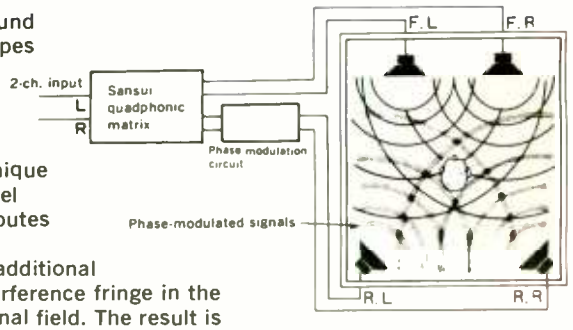

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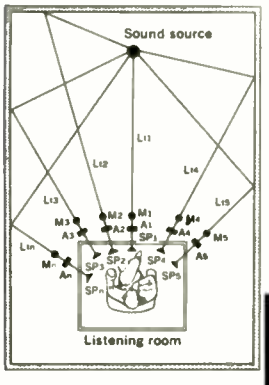

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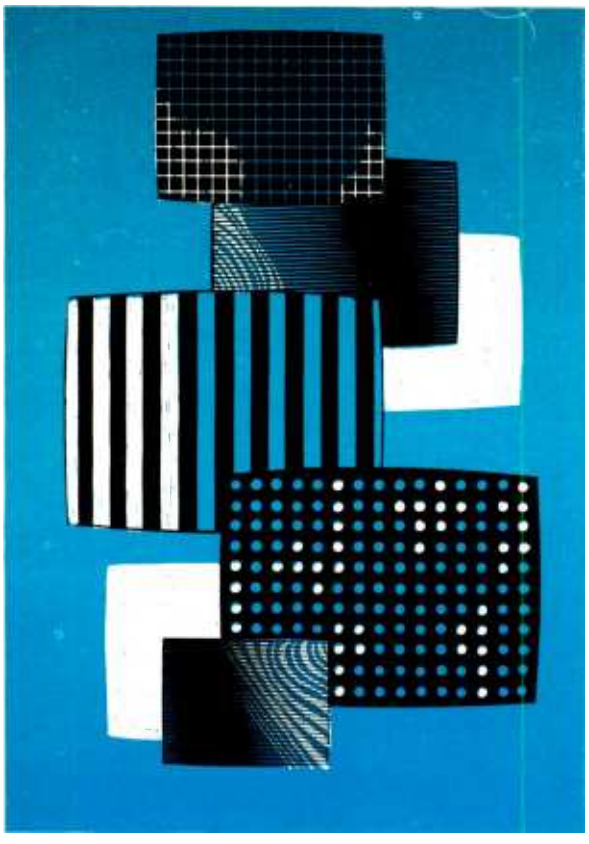


COLOR TV for 1971

By FOREST H. BELT/Contributing Editor

Part 1. More models and more screen sizes are being introduced in an effort to boost sales. There are a number of small-screen table models, many of which are Japanese-built. Here are details on the new circuit designs and trends.

SALES of color-television receivers dipped considerably during 1970. In 1968, sales were at an all-time high; almost 6 million sets were sold. Somewhat fewer were sold in 1969—only 5.7 million. Year-end figures haven't been tabulated, but 1970 sales will total barely over 4 million. That's the lowest year since 1965—when color had really begun to move.

Much of the blame is placed on our recessive economy. Loan money is scarce and costly and unemployment is high. Some observers blame other factors: boredom with TV programming, interest in other home-entertainment products (such as cassettes), and lack of color-set innovations.

A few suggest market saturation. They feel most people who can afford a color set already have one. About 35% of the sets in use are color. That's about the same as at the end of 1969. Only a price breakthrough, say the predictors, can make the proportion of color sets exceed 40%.

Into this gloomy sales picture come the 1971 models. There are more brands than ever. Our chart, which appeared in last month's issue, listed 31 major brands, including imports. More than a dozen other brand manufacturers gave us no chart information. Besides those, several small companies have been into color TV and back out in less than a year. Some companies large in other fields came in and then dropped back out.

There are more models than ever, too. Our chart listed 164 different chassis. Each one may be used in any number of models with various cabinets and picture-tube sizes. Last year, our chart of 1970 models listed only 104 chassis.

This proliferation is an attempt to bolster sales. Each manufacturer hopes to tailor its color-TV line so there's something for every potential buyer. There are more screen sizes. Some have the new square-corner picture tubes, some are small-screen models, some are the new 25-inch (viewable diagonal) picture tubes. Variety is the keynote of 1971 color-TV lines.

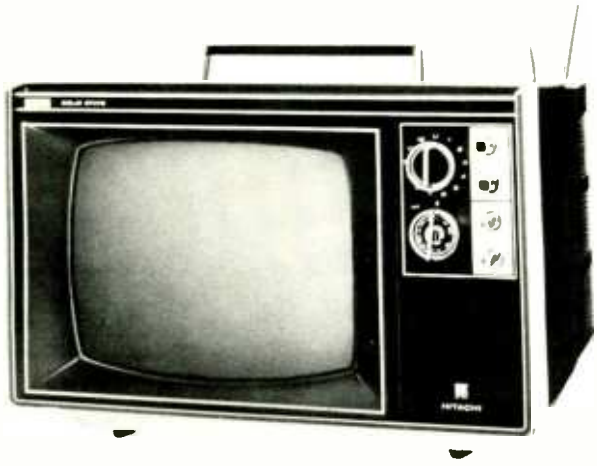


Fig. 1. Here is the first truly portable color receiver. Hitachi CWA-210 operates from 12-V car battery or from 117-V a.c. line.

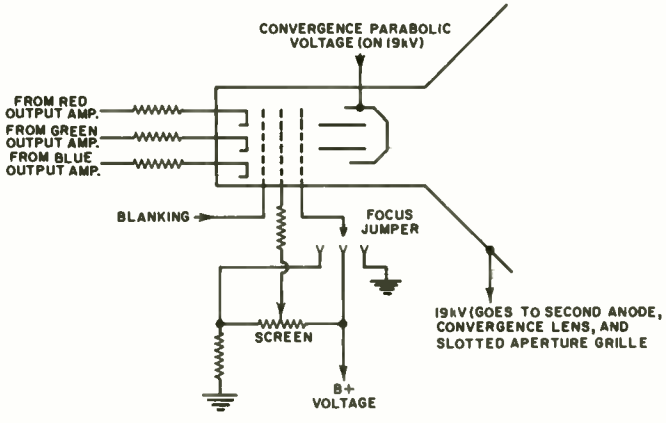


Fig. 2. The Trinitron picture tube has three cathodes in one gun; produces three beams. Used in 9- and 12-in Sony color portables.

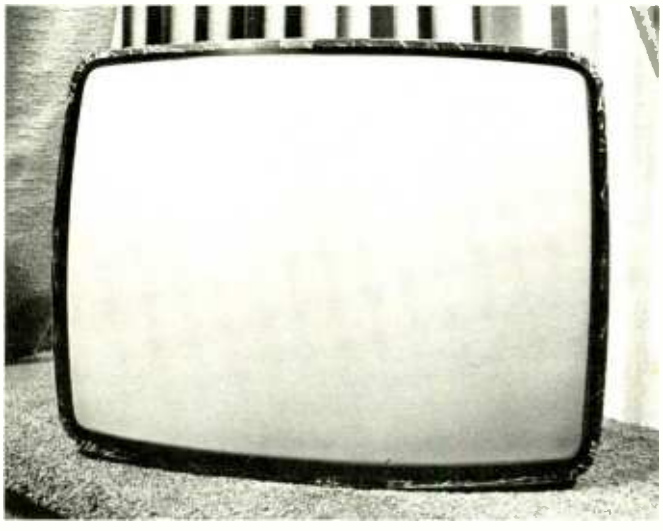


Fig. 3. Square-cornered, flat-face, 25-in color tube. This one from a Philco-Ford set has bonded safety plate. Picture height is the same as with older 21-in round tube except that new tube shows picture information formerly lost in the image corners.

One notable feature of the 1971 lines is the many portables. With them go a raft of small-screen table models, portable enough to be lugged or rolled from room to room.

We know of over 50 small-screen and portable chassis. There's no telling how many models that represents—probably well over 100. Many of the lightweight small-screen models with handles are Japanese-built.

Here's a tabulation of brands that offer screens of 16 (viewable diagonal) inches or smaller: *Admiral*—12, 16; *Arvin*—15; *Channel Master*—12, 15; *General Electric*—10, 14, 16; *Heathkit*—14; *Hitachi*—12, 14, 16; *Magnavox*—11, 14; *Midland*—11, 15; *MGA*—12, 14; *Motorola*—14, 16; *Olympic*—14; *Packard Bell*—12, 15; *Panasonic*—9, 12, 16; *Philco-Ford*—14, 16; *RCA*—14, 16; *Sharp*—12, 15; *Sony*—9, 12, 16; *Sylvania*—14; *Toshiba*—15; and *Zenith*—14, 16.

Only one manufacturer, *Hitachi*, has come up with a truly portable color set. It's a 12-inch model (Fig. 1) that runs on a 12-volt auto or boat battery, or on regular 117-volt a.c. house power. All others are bound to the power cord.

Panasonic demonstrated a battery portable color set with a 4½-inch screen. It weighs 17 pounds and runs on "D"-cells, a car or boat battery, or house current. It also has a built-in AM-FM radio. So far, no technical details are available, and no one knows when it will be for sale.

Sony has four models of its by now well-known Trinitron color set. The 9- and 12-inch Trinitron color picture tubes are one-gun, three-beam tubes with color phosphors in vertical stripes instead of dots. Fig. 2 shows how a Trinitron picture tube hooks up. The gun has three cathodes. The Y signal is matrixed with the three colors in the demodulator. So the signals coming to the CRT are color video, not color-difference signals. The control grid, screen grid, and focus grid are common to all three cathodes. Only one Screen control is necessary, and no gray-scale adjustments. The control grid is used only for blanking signals. Convergence is simple, involving only a half-dozen adjustments.

Speaking of special CRT's, the one used in all *General Electric* color portables is different from most. The phosphor dots are laid down in vertical rows instead of in triads. The guns in the CRT neck are in-line, not arranged in a triangle. Convergence is simpler, but not as simple as with a Trinitron.

For the first time, *Heath* has a color portable you can build. It's a scaled-down version of its new all-transistor color chassis. The circuits are built mainly on plug-in modular printed boards. The picture tube is a 14-inch size.

Squaring Up the Picture

One discrepancy since the inception of television has been the shape of picture-tube screens. Corners and sides of the picture are lost, especially when movies are shown. The aspect ratio of a transmitted TV picture is 3:4, but receiver picture tubes—especially for color—have never matched it.

All of a sudden they can. Improvements in glass and in deflection components have made possible a nearly square-cornered, nearly flat-face color screen. First size with square corners was 25 inch. The old 25-inch size had long ago been downgraded to 23 (viewable diagonal) inches by the Federal Trade Commission. The new tube, going into plenty of 1971 models, is a *true* 25 inch. (Labeled by the old method, it would have been a 26 inch.) The new shape of tube and mask gives 315 square inches of visible picture area. The old size and shape gives only 295 square inches.

One of the 25-inch square-cornered tubes is shown in Fig. 3. They're also available in 23-inch, 19-inch, and 18-inch versions.

Brands using the new 25-inch square-cornered CRT include: *Andrea*, *Electrohome*, *General Electric*, *Heath*, *Magnavox*, *MGA*, *Motorola*, *Packard Bell*, *Philco-Ford*, *RCA*, *Sylvania*, *Zenith*, and several of the private-label brands supplied by *Wells-Gardner*. Some of these set makers have smaller-screen models that use the square-cornered tube, too.

One set producer has another new kind of CRT. Deflection angles in color tubes until this year have been 70 degrees (the old) or 90 degrees (many late versions, including the square-corner flat-face CRT's). *RCA* developed an 18-inch color CRT with 110-degree deflection. In Japan, *Toshiba* has a 110-degree color tube in the 15-inch size, but it isn't in sets for U.S. sale.

Corning Glass, the company that produces much of the glass for picture tubes in this country, has made some changes in faceplates for 1971, too. A new formulation of faceplate glass contains strontium-90. This shields x-radiation caused by the high-energy CRT beam impinging on the shadow mask, phosphors, and face glass. Color tubes using strontium-90 glass can have high voltage up to 32 kV without causing radiation in excess of the standard 0.5 mR/hr measured 2 inches from the faceplate. With ordinary glass, 28 kV is about the maximum.

A real contribution to viewing is the black-surround matrix introduced a short while ago by *RCA* and *Zenith*. For 1971, a few other brands have this kind of picture tube. Among them are *Admiral*, *General Electric*, *Heath*, *Packard Bell*, and *Sylvania*. A few others may phase that kind of tube into their lines shortly.

The way it works in *Zenith's* "Chromacolor" tubes is illustrated in Fig. 4. The beams from the color guns go through the shadow mask (called *iris mask* or *aperture mask* in some brands) the same as usual. The black surround or matrix at each phosphor dot absorbs the hazy edges of each round beam. The phosphor dots can be driven by a larger beam that covers the entire dot.

The result is crisper color rendition, less glare from room light, and a much brighter-appearing picture. Whites have less contamination. Colors are more intense; they even look more natural.

Most black-surround tube faces are in larger screen sizes, particularly the new 25-inch square tube. *Zenith* has it in a 19-inch square-corner size. It and other makers also have 23-inch color CRT's with black-surround faceplates.

Many color-set manufacturers claim higher brightness. Some CRT's have more efficient phosphors than last year. Some use higher-transmission glass. Some have the black surround. Some include a combination of these improvements. Without a doubt, sets for 1971 generally provide clearer and brighter pictures than ever before.

Make Way for Transistors

The all-transistor color set is news again for 1971. Last year only *Motorola* and *RCA* had solid-state chassis—the TS-915 and the CTC40. *Hitachi* and *Sony* got solid-state chassis into the late fall line, but not many of the sets were available. For 1971, there's a whole lineup of transistor chassis. Here are some of their individual characteristics.

Heath Co. has four new solid-state color chassis you can build. Three are alike, the GR-270, GR-370, and GR-371; they merely use different-size picture tubes, 18-, 23-, and 25-inch. (See detailed article in last month's issue.) The GR-169 is a portable, using a 14-inch picture tube. The only tube in the four chassis is a 3CU3 high-voltage rectifier. Some integrated circuits are incorporated.

All *Hitachi* color sets for 1971 are transistor types. One thing unusual is the way signals in the i.f. section are handled in these sets. Fig. 5 illustrates how.

The first and second amps are ordinary transistor video i.f. stages. The signal is split at the output of the second stage. The high video i.f. amp is adjusted to respond mainly to the 45.75-MHz signal; there's no response at all below 43.0 MHz. That avoids the 920-kHz beat between 41.25 and 42.17 MHz. There's none produced in the video detector to make a moiré pattern on the screen.

The broad video i.f. amp has a response about equal at 42.17 and 45.75 MHz. The color signal is detected following this i.f. amplifier.

Sound signals can't get through the high video i.f. channel. However, the 4.5-MHz sound i.f. develops easily enough in the color detector. The 4.5-MHz FM signal is allowed to accompany the chroma sidebands and color sync through the first bandpass amplifier. Then sound i.f., chroma sidebands, and color sync are split apart and fed to their respective stages.

Motorola continues the TS-915 all-transistor chassis that was introduced three years ago—the first solid-state color set for sale in this country. It's still called the "Quasar." Circuit changes are minor. All Quasar chassis now use a h.v. rectifier built by *Varo*, a Texas company that developed the first really practical solid-state h.v. rectifier.

Panasonic has only one all-transistor model, the CT-991E. Its a.f.t. has two indicator lamps. A red one comes on when the fine tuning has drifted beyond range of the a.f.t. The viewer disables the a.f.t. and retunes until the red light goes out. A green lamp stays on whenever the a.f.t. is engaged.

The amplifiers that follow the color demodulator are peculiar to *Panasonic* sets. A block diagram is shown in Fig. 6. *X-Z* demodulation is used. An *X* amp and a *Z* amp follow

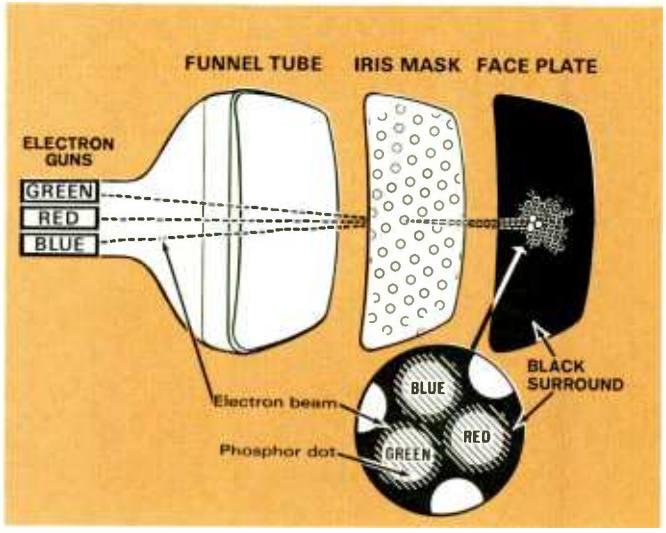


Fig. 4. Black-surround faceplate is another feature of many 25-in square-corner color picture tubes. The faceplate is also in some 19-in square-corner and 23-in standard CRT's.

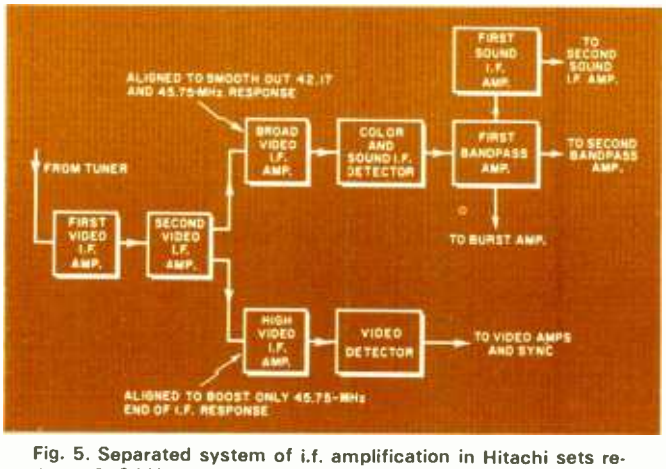
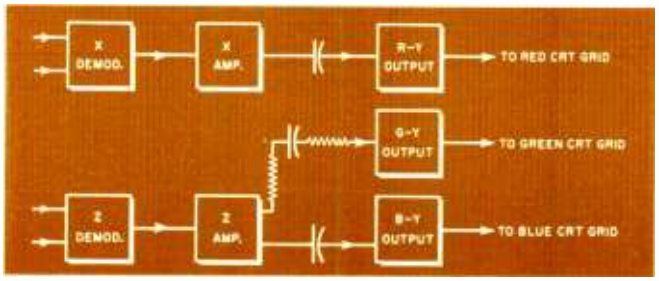


Fig. 5. Separated system of i.f. amplification in Hitachi sets reduces 920-kHz beat and improves frequency response for color.

Fig. 6. Amplifying X and Z phases before shifting G-Y gives two stages of gain for each color with only five transistor stages. Some Panasonic sets use tubes for three amplifiers.



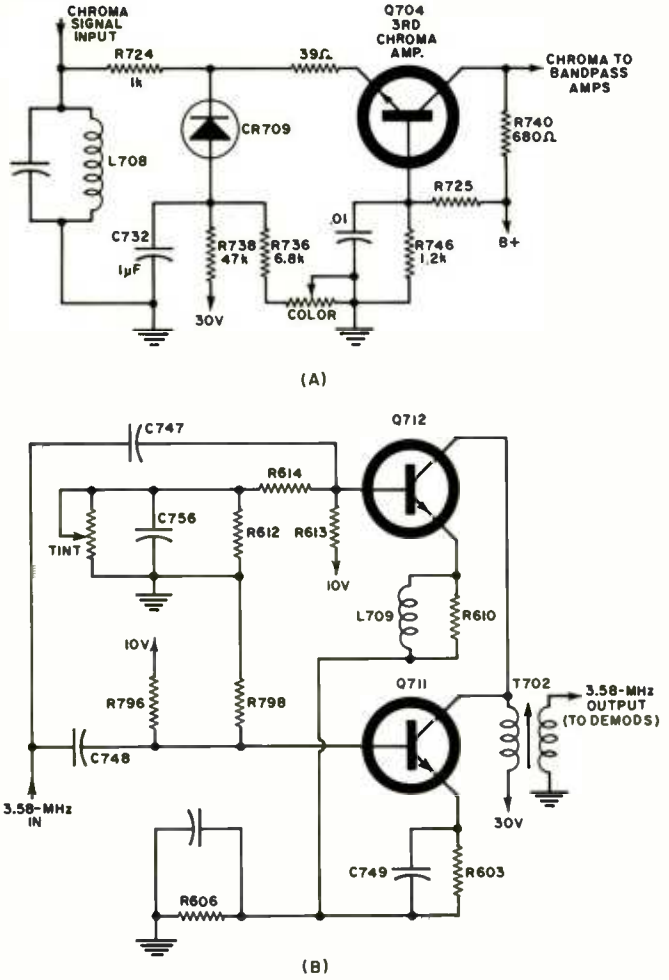


Fig. 7. D.c. is used to control (A) color and (B) tint in RCA CTC44 chassis. It makes remote control by d.c. memory modules easy.

each demodulator. Green is then developed, and the three color-difference signals are amplified by an output stage for each color. Hybrid chassis in the *Panasonic* line have transistor *X* and *Z* amps and tube color-difference amps. The CT-991E uses transistors for all five stages.

RCA has two new solid-state chassis, the CTC44 and the CTC49 (covered last month). The CTC44 is not a warmed-over CTC40, despite similarities. The silicon controlled rectifier horizontal-deflection system, unique to *RCA*, is retained. Improvements include a solid-state h.v. rectifier (the CTC40 has a 3CZ3 tube); d.c.-operated tint and color controls; a tint corrector, called Accu-Tint; and a detented 24-position u.h.f. tuner.

The d.c. color (saturation) and tint (hue) controls are shown, simplified, in Fig. 7. The Color pot (Fig. 7A) varies the forward d.c. voltage applied to diode *CR*709. Any conducting diode changes internal resistance as current through it is altered, and that characteristic is used to determine how much chroma signal reaches the base of chroma amplifier *Q*704.

Turning the pot clockwise cuts down the voltage reaching *CR*709. Less current flows in the diode (returned to ground for d.c. through *R*724 and *L*708). Its resistance becomes higher. Not as much chroma signal is shunted to ground by *C*732, so much of it reaches the transistor and is amplified.

Turning the control counterclockwise increases voltage applied to *CR*709, lowers its resistance, and lets *C*732 shunt more chroma signal to ground. Less reaches *Q*704, so less color signal passes on to the bandpass amps.

The d.c. tint control is diagrammed in Fig. 7B. The two transistors are fed the 3.58-MHz signal in parallel. The transistor outputs are in parallel, but not necessarily in phase. They share a common emitter resistor, *R*606, but each also has a phase-shift network in its emitter circuit.

From a d.c. standpoint, sharing the emitter resistor makes the transistors' behavior opposite. If base bias on one changes, it causes a bias change in the opposite direction in the other transistor. That of course also changes conduction in their respective collector circuits. From a signal standpoint, changing conduction of either transistor alters the effect of its phase network on the signal.

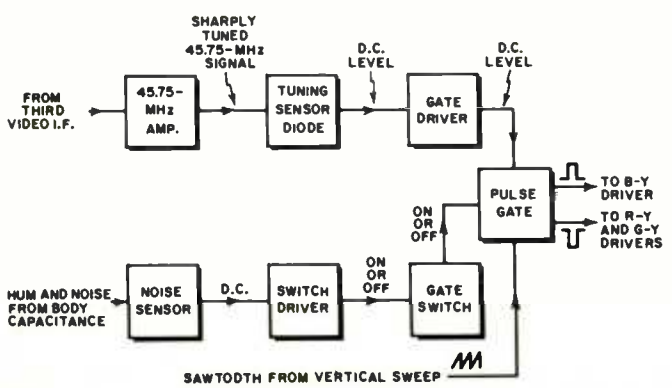
Now imagine turning the Tint pot to its minimum resistance. The base of *Q*712 becomes less positive and the transistor conducts less. The voltage change across *R*606 makes the *emitter* of *Q*711 less positive, which increases conduction in that transistor. The signal fed to *Q*712 is affected less by the inductive phase-shift network in the *Q*712 emitter circuit; the signal fed to *Q*711 is affected *more* by the capacitive network in the emitter circuit. The result is a net capacitive shift in the signal developed in *T*702. That phase shift changes the hue of color from the demodulators.

Turn the Tint control to maximum resistance and base of *Q*712 becomes more positive. *Q*712 conducts more. *Q*711, because of the differential action, conducts less. *L*709 therefore has more effect than *C*749 does. The net shift is inductive. The hue changes in the other direction.

Sony has three new transistor models, including one 9-inch portable. All use the Trinitron. The new 9-inch chassis has a couple of integrated circuits; 12-inch models have none.

Unique to the *Sony* Model KV1220U is a tuning aid called "Sky-Tuning." When a viewer reaches out and touches either the v.h.f. or u.h.f. tuning knob, a blue band appears at the top of the color screen. The viewer tunes to make the blue band its narrowest. Fig. 8 should help you understand how it's done.

Fig. 8. Positive-going pulse turns on B-Y driver for a few lines at top of picture in one Sony portable. Fine tuning changes how wide the pulse (and therefore the blue band) is.



Sensing the set's tuning is relatively simple. A tuned stage peaks sharply at 45.75 MHz. If the oscillator drifts, the i.f. shifts away from precisely 45.75 MHz. The signal output of the sensitive 45.75-MHz amp drops off.

A diode turns the output of this 45.75-MHz amp into d.c. If the fine tuning isn't exact, the diode has less signal to rectify. The level of d.c. sent to the gate driver therefore depends on how well the set is tuned. The gate driver is a d.c. amp that applies bias to the pulse-gate transistor.

Meanwhile, a sawtooth from the vertical sweep section is being applied to the pulse-gate stage. The gate transistor turns on when the voltage rise—the leading slope—of the sawtooth gets up far enough to override the bias (from the gate driver, remember). If bias is low because the d.c. level from the tuning sensor diode is low, the gate transistor turns on early and the resulting pulse is wide.

Bias gets high when the set is tuned correctly. The gate transistor can't turn on until the sawtooth voltage is far up the slope. That means it also turns off soon after, when the

(Continued on page 73)

Nomograms Aid Capacitance Calculations

By JAMES E. McALISTER

Unknown capacitances or parallel-plate air variables can be determined readily. Graphs can also help modify such capacitors to other values.

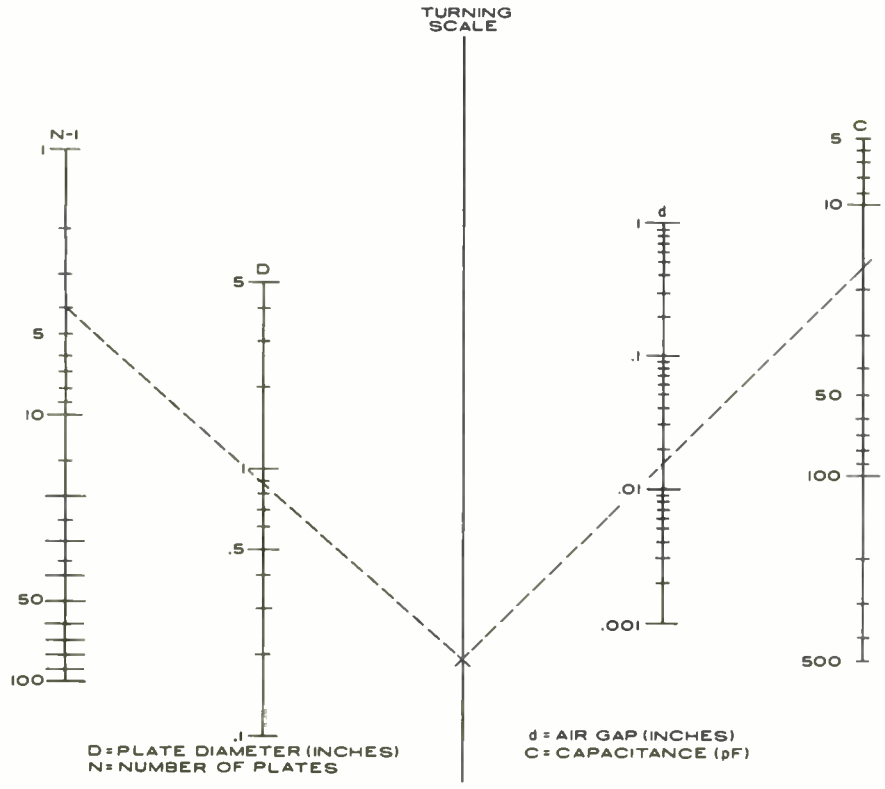
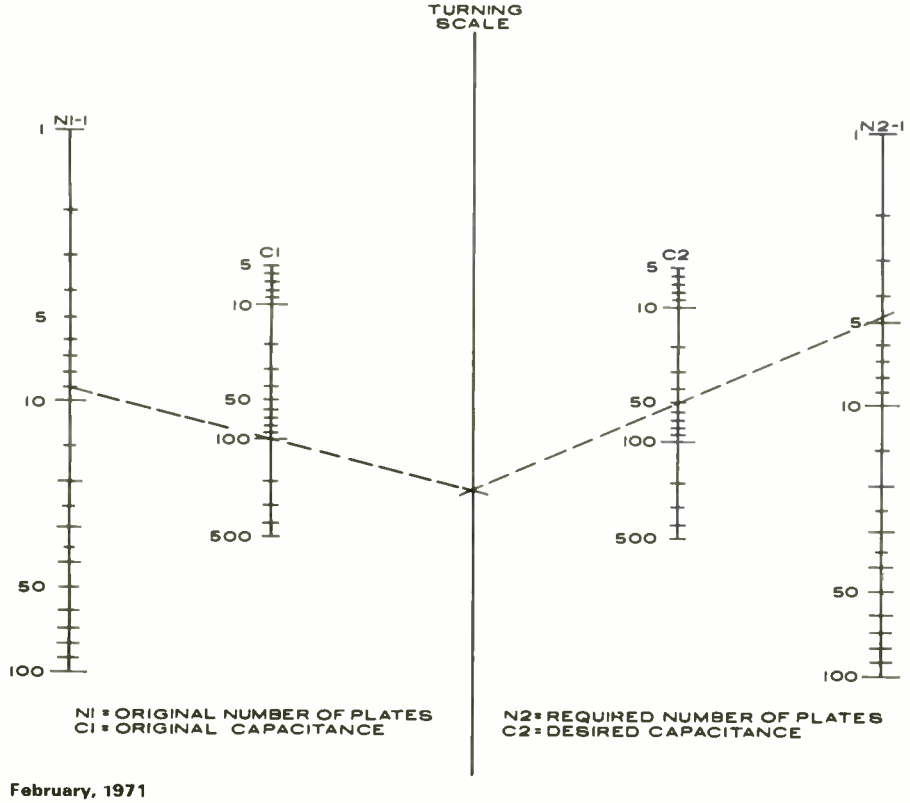


Fig. 1. Nomogram used to determine value of unknown capacitance.

Fig. 2. Nomogram used to modify capacitors by removing plates.



MOST electronics designers and experimenters have a myriad of variable capacitors of unknown capacitance in their possession. By using one of the nomograms presented here, an approximate value for maximum capacitance of many types of variables can be quickly calculated. In addition, a second chart gives aid in "customizing" a particular capacitor from almost any larger unit.

Many electrical handbooks give a formula for determining the capacitance of an unknown parallel-plate capacitor. In general terms, the formula can be expressed as:

$$C = 0.224KA(N-1)/d$$

where:

A = plate area in square inches
d = spacing between plates in inches
K = dielectric constant of material between the plates
N = number of plates
C = capacitance in picofarads

The nomogram in Fig. 1 essentially solves this equation, but two assumptions must be made. First, the plates must be approximately semicircular in shape. Slight variations from this shape will, however, not drastically affect results. Since most commonly used variable capacitors have semicircular plates, the nomogram has been designed (for simplicity) to handle only this type capacitor. Second, the material between the plates must be air ($K = 1$).

The variables of the nomogram are D, d, N–1, and C where:

D = plate diameter in inches
d = width (in inches) of air space between adjacent plates
N–1 = number of plates minus 1
C = unknown capacitance (in pF)

In order to test the accuracy of the nomogram, capacitance calculations for a *Hammarlund* HF-15 variable are shown in Fig. 1. The HF-15 has 5 plates (N–1 = 4), and the plate diameter (D) is 0.875 inch. A line is drawn, therefore, to connect 4 on the N–1 scale and 0.875 on the D scale. This line is extended so that it intersects the turning

(Continued on page 53)

Recent Developments in Electronics

Portable Communications Shelter. (Top left) Deep in a snow drift in the Lake Clark Pass area of Alaska is this portable communications shack. This one not only houses radio transmission gear but also thermoelectric generators to power the equipment and charge the batteries that are used. The generators will deliver 50 watts of power each, and as many as six are used in a single shelter. An efficient and wind-resistant gas burner, which can operate for long periods unattended, supplies the heat needed. Solid-state lead telluride alloys convert the heat from the burners into electricity. Waste heat from the generator thermopiles is used to provide a thermostatically controlled internal temperature for the occupants of the shelter and for the equipment. The building itself is constructed of leak-proof, seamless fiber glass, insulated with foam to conserve internal heat. Several of the shelters, built by 3M Co., have been successfully field tested for more than a year at three locations in the Lake Clark Pass area.

Built-in FM Loop Antenna. (Center) For as long as we can remember, Zenith Radio has been using printed-foil built-in antennas for its broadcast receivers. The latest one we have seen, dubbed "Wave-Sensor" by the company, is shown here. The antenna itself is a flat copper-foil loop printed on a dielectric plastic base, measuring about 5" in diameter. The ends of the loop have an interdigital pattern, probably to increase end capacitance and make the loop appear to be electrically larger. When the loop is in place, it covers the conical sound deflector which disperses the sound from the cylindrical receiver. The flat FM loop antenna should respond better to FM stations' mainly horizontally polarized signals as opposed to the usual vertical whip antenna, which responds best to vertical polarization.

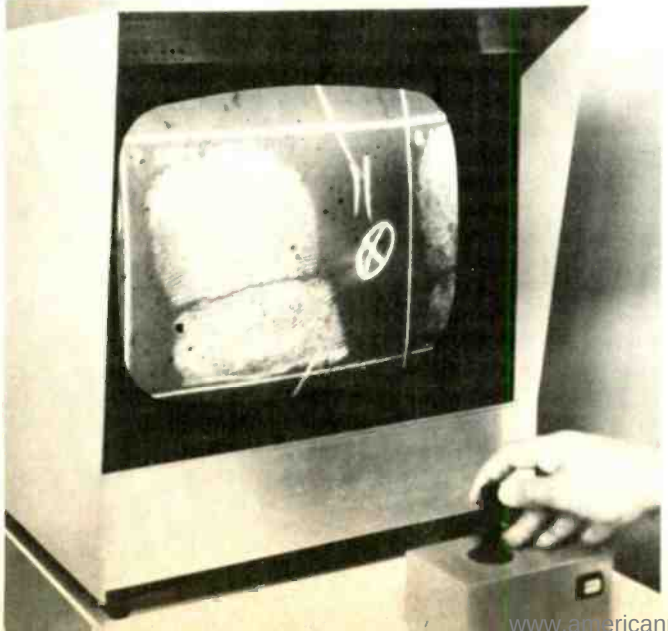
Electronic "Sniffing Pole" Checks Air Pollution. (Below left) This innocent-looking pole on the plaza is one of 31 detector masts with measuring boxes located throughout the Rijnmond region in Holland. Sixty-four times each hour, the poles test the air for sulphur dioxide content and report their findings via telephone lines to a computer at the warning center at Schiedam. Wind velocity and force are also measured. The system was developed by Philips of Eindhoven and is distributed in the U.S. by Philips Electronic Instruments. The air to be sampled is first passed through a heated fiber glass filter to remove the dust. Air is then fed through another special filter, in which nitrogen oxide, ozone, and other undesired matter is neutralized. Next, the air goes into a constant-temperature measuring cell containing a solution of potassium bromide, sulphuric acid, and bromine in water. The reduction-oxidation potential is measured by two electrodes and compared with a known reference potential. If the bromide-bromine equilibrium is upset by a reaction with sulphur dioxide, the difference between the two potentials activates a generator electrode via an amplifier so that a generator current converts the bromide ions which have been formed back into free bromine. The strength of the current depends on the amount of bromine used and consequently on the amount of SO_2 flowing through the measuring cell. The current is also used to determine the amount of output signal, which indicates the sulphur dioxide content of the air sample measured.

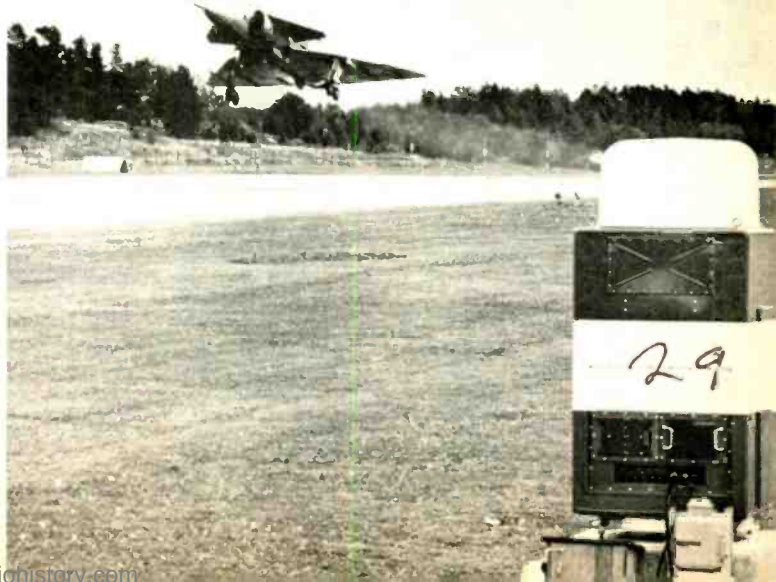
Office Computer for Engineers (Top right) "Conversational" problem-solving is a key feature of a versatile new small computer just announced by IBM. Engineers and scientists, as well as business people, can solve problems using Basic language. Engineers in the photo are using the computer to solve a complex structural design problem. Data is entered directly into the computer using a typewriter keyboard and is stored in the system's disc files. Output can either be printed or displayed on a visual display unit. The new computer, the System/3, Model 6, requires just 120 square feet of floor space; it will rent for about $1000 a month or may be purchased for $48,000.

Ultrasonics Tests SST Skin Panels. (Center) A brazed honeycomb titanium panel like that to be used on our supersonic transport's wing and tail outer skin is shown being tested. The 20-ft long panel is like the vertical fin panel of the U.S. plane now under development. Ultrasonic waves are being used by Boeing test engineers to check the strength and integrity of bonding of face sheets to the honeycomb core. A pulse echo ultrasonic inspection probe sweeps across the panel while the recorder at the left prints on paper an exact picture of the brazed bonds. Just about every inch of the plane's outer skin will be tested this way.

TV Fingerprint Monitor. (Below left) A remote TV monitor with a joystick scan and zoom control will be used to examine fingerprints at the Essex County, New Jersey sheriff's office. The monitor is part of a new high-speed microfilm information storage and retrieval system that will be installed by Mosler. A law-enforcement officer who may wish to review a complete criminal record can key the request and the data is presented visually on the monitor within seconds. Several users can request information at the same time. The system will take up only about 2 percent of the space presently needed for conventional paper records. It is hoped that eventually every police department in the country will be hooked up in the system.

Microwave Landing Guidance System. (Below right) One of the most advanced all-weather landing systems for military aircraft is shown being used here with Sweden's new jet combat aircraft, the Saab Viggen 37. The system, which uses a scanning beam of 15.5-GHz microwave energy, employs a small ground station adjacent to a runway and a receiver-encoder in the aircraft for the display. An advantage of this system, built by AIL, is that it does not have the siting problems associated with the widely used ILS (instrument landing systems). Perhaps systems of this type could be installed at smaller airports or those whose location makes installation cost of a conventional ILS prohibitive. It was near such an airport in Huntington, W. Va., that a recent air crash took the lives of 75 people, mostly Marshall University's football team.





TV SERVICE and SAFETY

By RAY E. HERZOG/Supervisor, Svce. Parts, TV Division, General Electric Co.

Here's what one TV set manufacturer is doing to make and keep his receivers safe.

HAVE you ever been tempted to select a replacement part in much the same way as the technicians did in the following three examples?

"I need a 3.3k-ohm, half-watt, carbon plate-load resistor. All that I have in stock is a 3.3k-ohm, one-watt, carbon. It's the same tolerance, and being more than the original half-watt it should work okay."

"I have a defective cathode bypass 60-μF electrolytic. Let's see now—the original capacitor is rated at 250 volts. I have a replacement 60-μF electrolytic rated at 50 volts. Since the cathode voltage is only about 25 volts, my replacement should work. (I wonder why the TV manufacturer used such a high-voltage type?)"

"The parts list for this TV set says to replace this resistor with a TV manufacturer's type only. Looks like an ordinary resistor to me. Besides, I don't have time to order it special, so I'll use one of my regular carbon resistors."

Selecting a replacement part is important. A manufacturer's service literature is the best guide for proper selection. Improper replacement parts can seriously affect the safety of TV sets. So that the technician may better understand these safety relationships, here are some basic thoughts on safety-related parts.

For Safety—No Substitutes Allowed

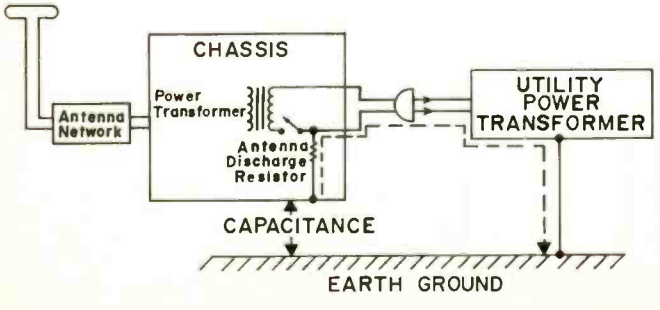
A replacement part may be safety-related because of its unique construction or special circuit application.

Some parts are selected by a TV set designer for their physical characteristics. For example, a flame-proof resistor, constructed with glass and metal, could in some applications be safer during overload or failure than a regular carbon composition type.

Equally important is a power transformer constructed with a certain wire size for adequate current handling and with correct insulation for voltage ratings and heat dissipation.

Now consider what this means. If a specially constructed resistor is mistakenly replaced by, say, a common carbon resistor, a possible safety problem can exist in the TV set. Or if a substitute transformer is used instead of the manufacturer's recommended type, too small a wire size or inferior insulation could mean overheating and eventual insulation breakdown. Furthermore, a primary-to-secondary short might create a shock hazard.

Fig. 1. Antenna discharge resistor keeps chassis safe from high charges that may be developed on antenna.



It is necessary, therefore, to *always use* a TV manufacturer's recommended replacement part for exact physical characteristics.

Not as easily understood is a part's circuit application safety relationship. For instance, consider the second question on the cathode bypass capacitor. The idea of using a 50-volt capacitor in a circuit developing 25 volts might seem reasonable. But why did the TV designer select a 250-volt capacitor?

The designer was thinking not only of the immediate "all's well" operation, but also of a possible trouble: namely, a tube plate-to-cathode short that could put a high "B+" voltage on this cathode capacitor. Rating the capacitor to withstand such a high voltage protects both it and the TV set from possible further damage due to a tube failure.

Another safety-related feature could be the plate-load resistor in our first question. When overloaded, that half-watt resistor might act as a fuse, opening to prevent prolonged excessive current, resultant heat, and possible fire. Unknowingly, a service technician could defeat the fuse function of the lower wattage resistor by replacing it with a higher wattage rating.

Other components which are safety-related include:

1. The a.c. power and high-voltage switches and controls with high voltage applied and/or with an insulated shaft. An inferior replacement or one with an uninsulated shaft could create a shock or fire hazard.

2. "B+" and high-voltage power resistors. A replacement with too high a wattage or one placed too near combustible material could create a fire.

3. Cathode, screen grid, and plate resistors for horizontal output, vertical output, video output, audio output, and 3rd i.f. tubes. A replacement with too high a wattage could fail to open on overload or failure, thus generating excessive heat.

4. Spark-gap device. One with a wrong voltage rating could not function properly and could thereby lead to failure in another part.

5. Power-handling transformers, such as horizontal output, vertical output, audio output, power supply. An inferior or improper replacement could overheat.

6. Fuses, circuit breakers, thermal cutouts. Obviously, a wrong rating could permit excessive heat to be generated.

7. High-voltage rectifier tube, high-voltage regulator

tube, and picture tube. A wrong type could produce excessive x-rays.

8. Across-the-line capacitor. A wrong type could fail and place a short across the a.c. input source.

9. Antenna discharge resistor. A wrong value or missing resistor could create a shock hazard.

Most of these parts can be recognized as having safety relationships. But a couple of them deserve a closer look.

One is the across-the-line capacitor. Typical values range from 0.01 μF to 0.22 μF. Some earlier types were rated at 600 V d.c. More recently, the voltage rating is 150 V a.c., 60 Hz. To be *UL*-approved, this capacitor must meet the following test:

"The capacitor shall be subjected to 4 discharges from a dump capacitor charged to a voltage value which, when discharged, will place a potential of 5 kV across the capacitor under test, with an interval of 5 seconds between successive discharges. During the discharge test, a 120-volt r.m.s., 60-Hz potential is to be applied across the capacitor under test. The 120-volt potential is to be maintained for 30 seconds after the 4th discharge unless the circuit is opened in a shorter time by failure of the capacitor. During the test a layer of cheesecloth shall be securely wrapped around the capacitor under test. Twenty-five pieces are to be tested with glowing or flaming of the cheesecloth permitted on 2 pieces. If the cheesecloth on 3 pieces glows or flames, 25 additional pieces may be tested. If more than 2 of the 2nd group of 25 samples glow or flame, the units are not acceptable."

Consider next the antenna discharge resistor. This resistor discharges to earth ground (through the power line) the high static voltages which can accumulate on the antenna due to lightning or electric charges in the air (Fig. 1). The voltage charges the capacitance between chassis and earth ground, since the antenna is connected to the chassis through the antenna balun and/or isolation network.

Without the antenna discharge resistor, or with one which has increased in resistance, the static charge must seek another path to earth ground. For a TV set having a power transformer, this other discharge path could be through the transformer—thereby possibly causing insulation breakdown and a shock hazard. Or, if the discharge does not occur, then a shock hazard exists between chassis and earth ground.

Even such an ordinary item as a wire tie gets special attention. For instance, the type now used in TV sets is self-extinguishing within 10 seconds to retard fire.

Safety depends not only on correct parts, but also on the installation and wiring of parts. After repairs have been made, a safety check should be performed. Such a safety check includes:

1. Checking lead dress to be sure that no leads or flammable materials touch power resistors, tube envelopes, or other heat-producing components.

2. Making sure that all lead restraints and insulating barriers are properly installed.

3. Measuring continuity between shorted blades of the power cord plug and exposed conductive surfaces (screws, antenna, handle, metal knobs, etc.).

For step (3) above, the manufacturer's service literature gives acceptable resistance values; these depend on circuit design and the antenna discharge resistor.

Equally important as continuity checking is checking to see that operating high voltage is properly set. Excessive high voltage can cause emission of x-radiation and can lead to an above-average number of failures and possible fire hazards.

Color It Gray

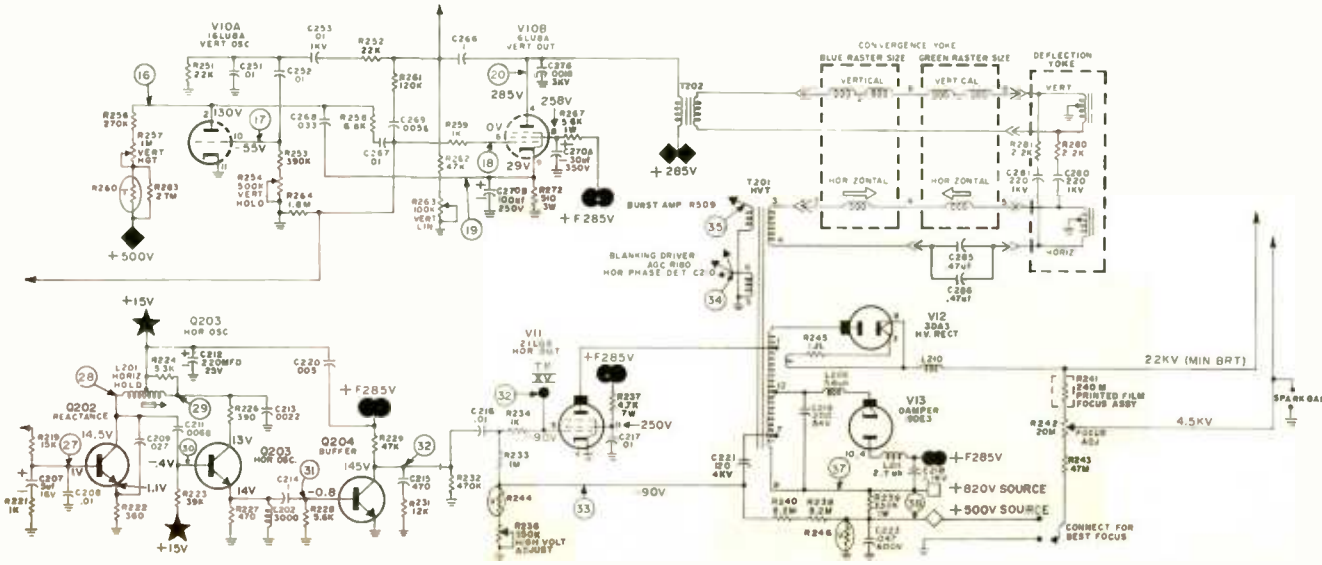
For convenience in ordering replacement items, TV manufacturers catalogue parts. Many of these catalogued parts have safety significance; some, however, are specifically safety related.

To help TV service technicians easily recognize certain safety-related parts, one TV manufacturer—*General Electric*—has introduced a unique approach: certain parts in the company's service manuals are shaded in gray in the parts list and schematic. And to emphasize the shading and the importance of considering safety with respect to all parts, an accompanying notice states:

"Product safety should be considered when a component replacement is made in any area of a receiver. The shaded areas of this parts list and the schematic diagram designate components in which safety can be of special significance. It is particularly recommended that General Electric *catalogued parts be used for component replacement in the shaded areas of this schematic. Use of substitute replacement parts which do not have the same safety characteristics as recommended in factory service information may create shock, fire, or other hazards."*

Note how in Fig. 2 the shaded gray commands attention when a service technician or parts distributor refers to the schematic. The replacement parts listing also uses gray shading to call out safety-related components. This shaded gray technique was first used with *G.E.'s* 25-inch KE color chassis and 16-inch Porta Color® chassis. ▲

Fig. 2. Partial schematic of G.E. receiver, showing the use of shading to call out the safety-related parts or sections.



Selecting a Video Tape Recorder

By AUBREY HARRIS/Chief Engineer, Electronic Systems
University of California, Santa Cruz

In the market for a VTR? Here are facts and figures about some available units that should help you make a more educated choice.

IN selecting a video tape recorder, there are many factors to be considered before a decision is made. One important aspect is whether tapes made on one model of recorder could be reproduced on recorders of another make. This is of vital concern in industry and education where tapes recorded at one location have to be reproduced on another recorder at a remote location. The interchangeability of tapes *within* one manufacturer's brand is now no longer a problem but complete and free circulation of pre-recorded tapes will only be possible when the number of different tape formats is reduced. At present, there are at least 15 formats encompassing tape widths of ¼-inch to 2 inches and tape speeds from 3.7 to 12 inches per second. An attempt at standardization has at last been made by the Electronic Industries Association of Japan (EIAJ) and is discussed below.

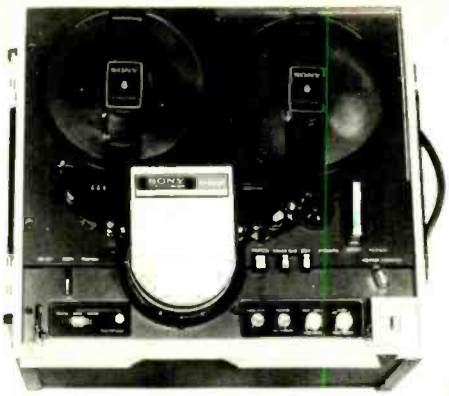
Other considerations in recorder choice could well be: how much does the tape cost for one hour's recording? Will it record color? Can tapes be edited? Does it work from batteries? These and other details are listed in Table 1.

Table 1. Directory of some of the most popular, low-priced video tape recorders.

Manufacturer	Model	Tape Width (in)	Tape Speed (in/s)	Record Playback Time (min)	Cost/hr of Record Time ($)	No. of Video Heads	Video Head Life (hrs)	VIDEO CHARACTERISTICS			Number of Audio Tracks
								Horiz. Resolution (lines)	Bandwidth (MHz)	Signal-to-Noise Ratio (dB)	
AMERICAN PHOTOCOPY EQUIP. CO. 2100 W. Dempster St. Evanston, Ill. 60204	VT-101	½	7.50	60	40	2	500	325	3.5	42	1
AMPEX CORPORATION 401 Broadway Redwood City, Cal. 94063	VR660C	2	3.70	300	60	2	250	330	4.2	42	2
	VPR4500	1	9.60	60	60	1	500	350	4.2	40	1
	VPR5200	1	9.60	60	60	1	500	300	3.0	39	1
	VPR5800	1	9.60	60	60	1	1000	350	4.2	44	2
	VPR7900	1	9.60	60	60	1	1000	350	4.2	48	2
	Instavision	½	7.50	30	26	2	1000	300	3.0	42	2
BELL & HOWELL CO. 7235 N. Linder Ave. Skokie, Ill. 60076	2966	½	7.50	60	40	2	1000	300	3.0	40	1
	2000	1	6.91	60	45	1	500	400	4.2	41	1
	2910	1	6.91	60	45	1	500	400	4.2	43	2
CONCORD ELECTRONICS CORP. 1935 Armacost Ave. Los Angeles, Cal. 90025	VTR-400	½	12.00	14	64	2	2000	260	2.0	40	1
	VTR-720	½	12.00	40	64	2	2000	250	2.5	40	1
	VTR-800	½	7.50	60	40	2	(1 yr)	300	2.0	40	1
	VTR-2300	1	8.57	67	60	2	2000	450	4.5	43	1
CRAIG CORP. 921 W. Artesia Blvd. Compton, Cal. 90220	6401	½	9.45	63	48	2	1000	250	3.0	40	1
	6402	½	9.45	63	48	2	1000	275	3.0	40	1
	6403	1	7.50	96	60	2	1000	400	4.5	42	2
	6407	½	7.50	63	40	2	X	270	2.6	40	1
DIAMOND POWER SPECIALTY CORP. Box 415 Lancaster, Ohio 43130	DP-1E	½	9.45	63	48	2	500	230	2.0	40	1
	DP-2	1	7.50	96	55	2	1000	350	3.6	42	2
	DP-3	1	7.50	96	55	2	1000	350	3.6	44	2
GPL TV SYSTEMS DIV.-Singer General Precision Inc. (Subsidiary of The Singer Co.) 63 Bedford Rd. Pleasantville, N.Y. 10570	VR-400	1	6.91	60	45	1	1000	400	4.2	43	2
INTERNATIONAL VIDEO CORP. 675 Almanor Ave. Sunnyvale, Cal. 94086	IVC-600	1	6.91	60	45	1	1000	350	3.5	43	1
	IVC-800	1	6.91	60	45	1	1000	400	3.5	44	2
	IVC-900	1	6.91	195	45	1	1000	400	4.0	48	2

SPECIAL NOTES: Tapes recorded on machines of one manufacturer are not normally reproducible on machines of other manufacturers unless specifically stated (See Tables 3 and 4.) A. Automatic gain control; B. Remote control capability; C. Records/Plays color; D. Records NTSC color; plays monochrome only; E. Color (Record/Play) optional for additional $500; F. Color (Record/Play) optional for additional $700; G. Color (Record/Play) optional for additional $1000; H. Color (Record/Play) optional for additional $2400.

(A) Panasonic NV-3020 ▶



◀ (B) Sony AV-5000

(D) IVC-900 ▼

▲ (C) Shibaden SV-707

MAIN AUDIO CHANNEL CHARACTERISTICS						PHYSICAL CHARACTERISTICS						
						Dimensions (in)						
Bandwidth (Hz)	Signal-to-Noise Ratio (dB)	Micro. Input Imp. (ohms)	Line Input Imp. (ohms)	Output Level	Output Imp. (ohms)	W	H	D	Weight (lbs)	Power Dissipation (W)	Special Notes	Basic Cost ($)
60-10,000	42	10K	10K	−14dBm	10K	18 3/8	10 3/16	15 11/16	52.8	95	J	995
50-9000	45	50K	600	+8dBm	600	29 7/8	14 5/8	17 3/8	100	400	B,C,K,L,M	10,450
90-9000	42	P	P	1.0V	10K	26 1/4	12 1/4	18 1/4	73	285	E,P	1650
90-9000	42	200	100K	1.0V	10K	26 1/4	12 1/4	18 1/4	78	285	B,J,K,Y	2600
75-12,000	45	200	100K	+4dBm	600	26 1/4	12 1/4	18 1/4	85	285	B,F,K,L,M,Y	4900
50-15,000	50	200	100K	+8dBm	600	38 1/8	12 1/4	18 1/4	150	585	B,H,K,L,M,S,Y	13,000
100-10,000	40	10K	–	–	600	11	4 1/2	13	15	8	A,C,J,K,L,M,W	1000
60-10,000	40	10K	10K	−14dBm	2200	19	10.6	16.3	52	95	–	995
75-10,000	40	200	600	+4dBm	600	25	10	14	47	200	B,D,E,M	1835
80-10,000	40	200	600	+4dBm	600	23 5/8	11 3/8	13 1/2	66	350	B,D,E,M	4200
80-10,000	40	1000	–	N	N	14 3/8	4 5/8	9 1/4	15	7	A,N,U	1350
50-12,000	42	10k	20K	0.1V	600	16 1/2	10	16 1/2	60	180	A,B,J,K,M,V,Y	1395
80-10,000	40	10K	50K	0.1V	600	15 7/8	8 5/8	15 3/8	33	60	A,M,Y	695
40-20,000	46	600	100K	+8dBm	600	24 7/8	12 1/2	16 5/16	97	260	B,J,L,M,Y	3950
70-10,000	40	10K	10K	0.775V	2K	21 3/4	13 3/4	17 3/4	65	80	–	750
70-10,000	40	10K	10K	−10dBm	30K	18 1/2	10 1/4	17 1/2	59	80	K	1200
60-10,000	45	10K	10K	+4dBm	600	25	18 1/2	21	160	300	K	4200
70-10,000	40	600	50K	0dBm	600	16 3/4	9	15 1/2	36.6	80	A,K,M	945
70-10,000	40	10K	30K	0dBm	2K	19 3/4	11	17 1/2	60	70	A,K,L,M	1195
60-12,000	45	10K	10K	+4dBm	600	25	18 1/2	21	130	350	B,K,L,M	4450
60-10,000	45	250	10K	+4dBm	600	25	18	20 1/2	180	400	B,K	9925
75-10,000	40	200	600	+4dBm	600	24	10 1/2	13 1/2	57	300	B,D,E,M	4200
75-10,000	40	200	600	+4dBm	600	25	10	14	47	200	B,D,E,M	1980
75-10,000	40	200	600	+4d3m	600	24	11 1/2	13 1/2	78	350	B,D,E,M	4200
50-10,000	45	200K	600	+4dBm	600	32	18	19	225	750	B,G,H,K,S	12,000

J. R.F. output provided for feeding direct to TV receiver; K. Includes editing; L. Includes slow-motion playback; M. Includes stop-motion playback; N. Record only; P. Play only; Q. Price includes receiver/monitor; R. Price includes one reel of videotape; S. Simultaneous r.f. monitoring while recording; T. Battery powered, price includes charger; U. Price includes camera, recorder and microphone; V. Built-in head cleaning system; W. Stereo audio capability also provided; X. New product; data not yet available; Y. Audio dubbing

Tape Width	½ inch (12.7 mm)
Tape Speed	7.5 in/s (190.5 mm/s)
Head Cylinder Diameter	4.55 inches (115.82 mm)
Video Track Angle (tape stationary)	3° 11′
Video Pitch	173 μm
Audio Track Width	1.0 mm
Control Track Width	0.8 mm

Table 2. EIAJ Type I standards for ½-in video tape recorders running at 7.5-in/s with a 4.55-in diameter head cylinder.

Table 1 lists only recorders utilizing reel-to-reel magnetic tape transports. During the past several months a number of new developments have been announced, many of which seem to be aimed at the educational markets although the ultimate target is widespread home use. Long-range plans are now being made which will, no doubt, eventually provide a video player in every home—the visual equivalent of the long-playing record. The reproduced pictures will be displayed on a color-TV set and the addition of a low-cost TV camera to the tape system will give the equivalent of "instant-replay home movies."

Recent developments are video tape cartridge recorder/players by *Ampex* and *Matsushita* (*Panasonic*) operating on the EIAJ, Type I, ½-inch tape standards. The cartridge transports are self-threading and can play tapes which have been recorded on standard reel-to-reel machines.

Sony has announced the "Videocassette," a magnetic tape cassette unit providing a playing time of up to 90 minutes. The price of the recorder/reproducer is expected to be around $350, with the cassette cost about $20. The company hopes to encourage producers of motion pictures, television programs, and instructional material to distribute their programs in the Videocassette format. The machine will also be able to record directly from a TV receiver with an additional accessory.

Another entry into the home video market is *Avco Corporation* with its "Cartrivision" (CTV). This uses a magnetic video-tape cartridge, and a combined system will be sold containing a color-TV receiver and a cartridge recorder/player in one assembly for $800-$900. The unit will play pre-recorded tapes through the receiver or will record on blank cartridges either programs being received by the TV set or from a monochrome TV camera. It is anticipated that pre-recorded feature-length movies will be able to be rented for under $5.00.

Three other giants already in the entertainment field in a big way, *RCA* and *CBS-Motorola*, have systems for reproducing pre-recorded programs only. On these machines recordings cannot be made on the home unit.

Manufacturer	Model	Tape Width (in)	Tape Speed (in/s)	Record Playback Time (min)	Cost/hr of Record Time ($)	No. of Video Heads	Video Head Life (hrs)	VIDEO CHARACTERISTICS: Horiz. Resolution (lines)	VIDEO CHARACTERISTICS: Bandwidth (MHz)	VIDEO CHARACTERISTICS: Signal-to-Noise Ratio (dB)	Number of Audio Tracks
PANASONIC· Matsushita Electric Corp. of America 200 Park Ave. New York, N.Y. 10017	NV-504	1	8.57	67	60	2	1000	450	4.5	40	1
	NV-505	1	8.57	67	60	2	1000	450	4.5	40	2
	NV-8100	½	12.00	40	60	2	1000	220	2.0	40	1
	NV-8100AD	½	12.00	40	60	2	1000	260	2.0	40	1
	NV-3020	½	7.50	63	40	2	1500	300	2.5	40	1
PHILIPS BROADCAST EQUIPMENT CORP. 1 Philips Pkwy. Montvale, N.J. 07645	LDL-1000/52	½	7.90	38	56	2	500	200	2.2	42	1
	EL-3403/55	1	7.00	60	60	1	500	325	3.8	40	1
RCA CORP., Commercial Electronic Systems Div. Front & Cooper St., Camden, N.J. 08101	RCA-600	1	6.91	60	45	1	1000	350	3.5	43	1
	RCA-800	1	6.91	60	45	1	1000	400	3.5	44	2
	RCA-900	1	6.91	195	45	1	1000	400	4.0	48	2
ROBERTS-Califone Roberts Electronics Div. Rheem Mfg. Co. 5922 Bowcroft St. Los Angeles, Cal. 90016	VTR-1000	¼	11.25	40	30	2	1000	200	2.6	40	1
	VTR-1050AV	¼	11.25	20	30	2	1000	200	2.6	40	1
SHIBADEN CORP. OF AMERICA 58-25 Brooklyn-Queens Expy. Woodside, N.Y. 11377	SV-700UC	½	7.50	60	40	2	1000	300	3.5	40	1
	SV-707U	½	7.50	20	40	2	1000	300	3.5	40	1
	SV-800UC	½	7.50	60	40	2	1000	300	3.5	40	1
	SVC-727	1	8.00	90	60	2	1000	360	4.5	42	2
SONY CORP. OF AMERICA 47-47 Van Dam St. Long Island City, N.Y. 11101	AV/AVC-3400	½	7.50	30	40	2	–	300		40	1
	AV-3600	½	7.50	60	40	2	–	300	–	40	1
	AV-3650	½	7.50	60	40	2	–	300	–	40	1
	AV-5000	½	7.50	60	40	2	–	300	–	40	1
	EV-300	1	7.80	60	60	2	(1 yr)	300	–	43	2
	EV-320	1	7.80	60	60	2	(1 yr)	300	–	43	2
VICTOR CO. OF JAPAN LTD. 1, 4-Chome Nihonbashi-Honcho Chuo-Ku Tokyo 103, Japan	KV-340	½	7.50	63	40	2	X	270	X	40	1
	KV-600	1	7.50	96	60	2	1000	350	3.6	42	2
	KV-810	½	9.45	63	48	2	1000	230	–	40	1
	PKV-830	½	9.45	20	48	2	1000	230	–	40	1
WOLLENSAK-3M Company Mincom Div., 3M Center St. Paul, Minn. 55101	VTR-150	½	7.50	60	40	1	2000	160	2.0	35	1

SPECIAL NOTES: Tapes recorded on machines of one manufacturer are not normally reproducible on machines of other manufacturers unless specifically stated (See Tables 3 and 4.) A. Automatic gain control; B. Remote control capability; C. Records/Plays color; D. Records NTSC color; plays monochrome only; E. Color (Record/Play) optional for additional $500; F. Color (Record/Play) optional for additional $700; G. Color (Record/Play) optional for additional $1000; H. Color (Record/Play) optional for additional $2400;

The *RCA* equipment, known as "SelectaVision," is expected to retail at about $400. It uses inexpensive ($10 for half an hour) embossed, clear plastic tape as the recording medium. The recording is in the form of a hologram on the plastic and is reproduced by a low-power laser contained within the SelectaVision player.

Electronic Video Recording (EVR), developed by *CBS* and to be marketed by *Motorola*, uses a sealed cartridge containing 750 feet of ⅜-inch film for a 25-minute program.

The EVR player contains a flying-spot CRT scanner and has an r.f. output which connects directly to a TV receiver in place of the regular antenna. Players are now being sold at $795 for color or monochrome: presumably this cost will have to be somewhat lower to make an impact on the home market. The color cartridges sell for $18.50 (25-minute program) where the original material is being copied onto cartridges in quantities of 2000.

Standardization

One long-existing problem which has been facing the video-tape recorder industry for years is that of interchangeability among recorders manufactured by different companies. A big step towards solving this problem was taken in late 1969 when the Electronic Industries Association of Japan published standards for video tape recorders. The Type I standard specifies ½-inch tape running at 7.5 inches per second with a head cylinder diameter of 4.55 inches (see Table 2).

The head cylinder, around which the tape is guided and which contains the two scanning video heads, determines the angle which the video heads trace on the tape. In the EIAJ, Type I standard this diameter is different from other VTR's utilizing ½-inch tape running at 7.5 inches per second. Thus, it is not possible to play Type I standard tapes on non-standard ½-inch recorders or *vice versa*.

However, at least nine companies are designing or manufacturing recorders to these new standards: *Ampex, Hitachi, Matsushita, Mitsubishi, Sharp, Shibaden, Sony, Toshiba,* and *Victor.* So far, no manufacturers outside of Japan, other than *Ampex Corporation*, have announced that they

(Continued on page 51)

Table 3. Listing of some ½-in tape, 7.5-in/s recorders built to EIAJ Type I standards. Tapes made on one recorder will reproduce satisfactorily on any other.

Ampex Instavision	Panasonic 3080
Concord VTR-800	Sony AV3400
Craig 6407	Sony AV3600
Hitachi VT-13C0H	Sony AV3650
Panasonic 3020 (Photo A)	Sony AV5000 (Photo B)
Victor KV-340	

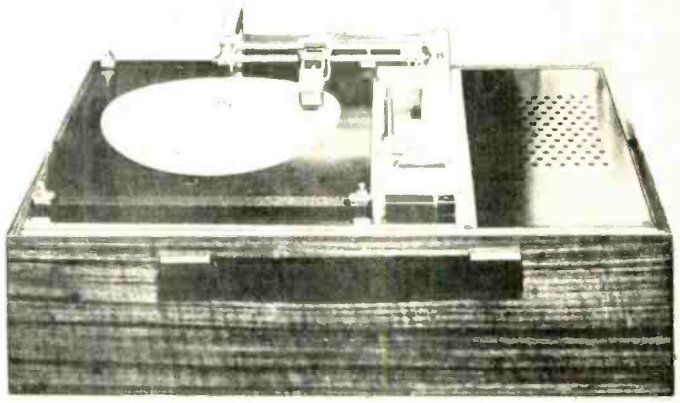
MAIN AUDIO CHANNEL CHARACTERISTICS						PHYSICAL CHARACTERISTICS						
						Dimensions (in)						
Bandwidth (Hz)	Signal-to-Noise Ratio (dB)	Micro. Input Imp. (ohms)	Line Input Imp. (ohms)	Output Level	Output Imp. (ohms)	W	H	D	Weight (lbs)	Power Dissipation (W)	Special Notes	Basic Cost ($)
80-8000	46	600	100K	0dBm	600	29 3/8	12 1/8	15 3/8	97	260	B,L,M	3950
40-20,000	46	600	100K	0dBm	600	30 3/8	11 3/4	16 3/4	120	265	B,J,K,L,M	5000
80-10,000	40	20K	1M	0.1V	600	17 1/4	10 5/8	17	53	160	M,Y	850
80-10,000	40	20K	1M	0.1V	600	17 1/4	10 5/8	17	63	165	A,B,K,Y	1400
80-10,000	40	20K	1M	0.1V	600	15 5/8	8 5/8	15 3/8	33	60	A,E,M,Y	700
120-10,000	40	1000	–	1V	20K	16 1/2	7 3/4	13 3/8	26	75	R	695
120-10,000	40	1000	600	2V	600	19 5/16	9 1/2	15 1/2	48	100	A,B,L,M,R	2195
75-10,000	40	200	600	+4dBm	600	25	10	14	47	200	B,D,E,M	1980
75-10,000	40	200	600	+4dBm	600	24	11 1/2	13 1/2	78	350	B,D,E,M	4200
50-10,000	45	200K	600	+4dBm	600	32	18	19	225	750	B,G,K,S,Y	12,000
100-10,000	45	100K	600	–10dBm	10K	17 1/2	19	11 1/2	66	170	A,B,W	1095
100-10,000	38	600	–	–10dBm	100K	10 3/8	4 3/8	10	10	14	A,R,T,U	1500
60-10,000	40	10K	10K	–14dBm	–	18 3/8	10 1/4	15 3/4	53	95	A,K,M	995
60-10,000	40	600	–	–14dBm	–	15 3/4	4 9/10	7 9/16	15	10	A,T,U	1395
60-10,000	42	10K	10K	–14dBm	16	30	11	17 1/2	75	125	A,K,M	1295
50-10,000	46	600	600	+4dBm	600	22	22	15	132	400	A,C,K,L	5950
100-10,000	–	3.6K	–	–	10K	11	6 3/16	11 5/8	18.75	12	A,M,R,T,U,Y	1495
80-10,000	40	600	10K	1.0V	10K	15 3/4	9 3/16	13 3/16	33	60	A,M,R,Y	695
80-10,000	40	600	10K	1.0V	10K	16 3/16	8 3/16	15 11/16	42	70	A,L,M,Y	995
80-10,000	40	600	100K	1.0V	10K	18 1/4	11	15 1/2	55	95	A,C,K,L,M,Y	1250
50-12,000	40	600	10K	+4dBm	600	18 13/16	11 1/8	19 3/16	77	150	B,L,M,R,Y	2450
50-12,000	50	600	10K	+4dBm	600	18 3/4	10 1/4	19 1/4	86	150	B,G,K,L,M,R,Y	4900
100-10,000	40	600	50K	0dBm	600	16 3/4	9	15 1/2	36.6	80	A,K,M,Y	945
60-10,000	45	250	600	+4dBm	600	25	18	20 1/2	180	–	B,D,K	8000
70-8000	40	–	–	1.0V	2K	18 3/4	10 1/4	17 1/2	59	–	B,K,L	1200
100-8000	40	–	–	1.0V	2K	12 3/4	5	10	15	–	A,T,U	2000
50-10,000	40	10K	10K	0.5V	10K	20	9 1/2	14	50	140	R	1095

J. R.F. output provided for feeding direct to TV receiver; K. Includes editing; L. Includes slow-motion playback; M. Includes stop-motion playback; N. Record only; P. Play only; Q. Price includes receiver/monitor; R. Price includes one reel of videotape; S. Simultaneous r.f. monitoring while recording; T. Battery powered, price includes charger; U. Price includes camera, recorder and microphone; V. Built-in head cleaning system; W. Stereo audio capability also provided; X. New product; data not yet available; Y. Audio dubbing

The Teldec Television Disc

By AUBREY HARRIS/Chief Engineer
Electronic Systems, Univ. of California, Santa Cruz

Details on a revolutionary disc that may become the video equivalent of the long-playing hi-fi phonograph record.



Prototype of the video disc player recently demonstrated in U.S. ▶

SINCE the earliest days of television a simple way of recording television programs has been sought. Indeed, in England as long ago as 1927, that great television pioneer, John Logie Baird, successfully produced phonograph-type recordings of his television signals. In those days, TV was a 30-line, 30 frames-per-second, non-interlaced system and he used a 78-r/min disc for recording the picture; a second disc was used for the accompanying sound.

At that time the video bandwidth was on the order of 10-15 kHz. Present-day television requires a bandwidth of between 3 and 5 MHz—about *three hundred* times greater.

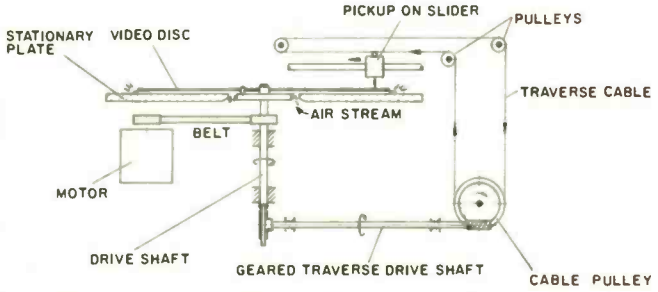
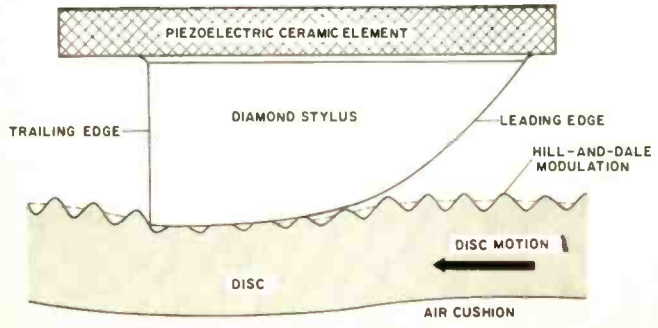


Fig. 1. The mechanical assembly of the Teldec player. A motor drives a common shaft for rotation of the disc and also for moving the pickup assembly radially across disc surface.

Fig. 2. Stylus tip in contact with the disc surface. The curved leading edge temporarily deforms the PVC surface. The pressure relief at the trailing edge of the stylus is transmitted to the piezoelectric ceramic element above.



Many factors combine to prevent satisfactory recording of such high frequencies and wide bandwidths directly onto regular LP-type discs.

First, the pickup would need a stylus of an impracticable, miniature size, with a radius smaller than 40 microinches (.001 mm) in order to resolve the small wavelengths corresponding to the high frequencies of the system. Second, the mass of the stylus would certainly not be able to trace successfully the oscillations of the record grooves at rates of up to several million times per second.

Some five years ago a team of inventors, Dr. Gerhard Dickopp, Edouard Schuller, Hans Joachim Klemp, Horst Redlich, and Arthur Haddy from *AEG-Telefunken* in Germany and *Decca* in England started work on a phonograph-type TV disc. Their efforts resulted in a revolutionary development, the *Teldec* (consortium owned by both companies) disc which seems destined to become the video equivalent of the 33⅓-r/min LP hi-fi record. Demonstrations were given for the first time in Berlin and London last summer and just recently in New York. Observers found black-and-white picture quality to be excellent, although occasionally there were noise streaks with some of the discs.

When the player is marketed, in about eighteen months' time, it will probably sell for about $150 as a singles player and about $250 as an auto-changer. The manufacturing cost of records for one hour's playing time is estimated at between two and three dollars; retail prices will depend on the various markups and on the nature of the program material. For playback, the unit is connected by wire to the antenna terminals of a television receiver and the picture viewed by tuning to an unused channel.

Although it has been likened to the LP, the *Teldec* disc is notable for its many dissimilarities to present-day audio discs. In the first place, it is very much thinner, being only one-millimeter thick and is pressed from a sheet of PVC (polyvinyl chloride thermoplastic material). In use it revolves once for every TV frame (two fields) at 1500 r/min for 50-Hz European television systems and at 1800 r/min for 60-Hz U.S. systems. The spacing between adjacent grooves on the disc is about 280 microinches (.007 mm), with a density of about 3500 grooves per inch (140 per mm). The grooves on an LP are some 10 to 14 times wider

than are the grooves that are employed on the video disc.

The pickup is a pressure-sensitive, piezo-ceramic unit instead of a velocity-sensitive cartridge, and it is moved across the disc surface by a positive mechanical drive as opposed to the groove guiding the stylus as on conventional records. The groove modulation is hill-and-dale (up-and-down) instead of lateral (side-to-side). The sound is carried on the same groove as the picture by pulse position modulation (PPM), which records the audio signals during the horizontal blanking portion of the video signal.

The video bandwidth is at present 3 MHz (black-and-white) with a signal-to-noise ratio of 40 dB. It is expected there will be a color version available within two years. The playing time is five minutes for a 9-inch disc and twelve minutes on a 12-inch disc.

The record discs themselves are produced very simply by stamping the groove impression on PVC foil in a high-speed press, using a metal matrix. The matrices are formed by an electroplating process (similar to that used in making phonograph records) from a master disc made on a master cutting recorder. The video input to this is from film reproduced by a flying-spot scanner.

The Disc Player

There is no actual turntable on the *Teldec* player; instead the disc is carried around at 25 or 30 revolutions per second by a central hub with a drive-pin device. The disc itself rotates on a cushion of air above a stationary platter. The air stream is produced in the machine and guided through cavities at the periphery of the hub. (See Fig. 1.) The air cushion produces a stabilizing effect on the disc foil and the vertical disturbance at the surface of the latter is less than 0.002 in (.050 mm).

The drive motor, apart from turning the disc hub, also drives a traverse cable for moving the pickup assembly across the disc surface. A simple drum, cable, and pulley arrangement is used to move the pickup by one groove-space dimension, 280 microinches (0.007mm) for each revolution of the disc. The groove depth is between 20 and 40 microinches. Stop-motion effects can be produced by disabling the drive to the traverse pickup cable.

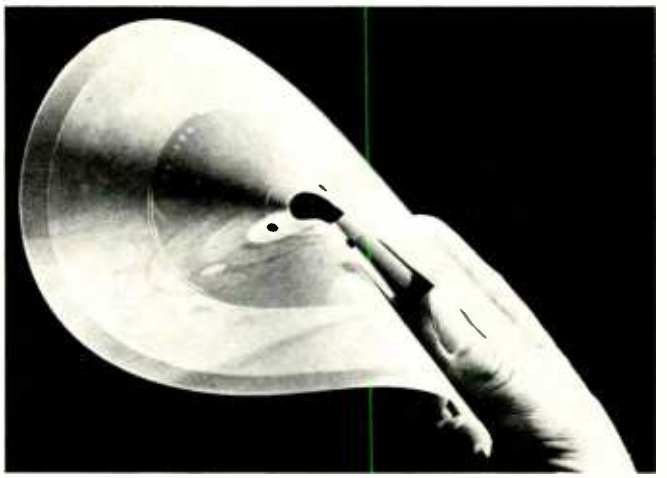
The pickup device is really the vital part of the whole system. The stylus itself is made of diamond or sapphire material and is rigidly connected to a piezoelectric-ceramic transducer. The electrical output of the transducer is taken from electrodes at its side and is on the order of 2 mV.

An illustration of the stylus tip in contact with the disc surface is shown in Fig. 2. It will be seen that the tip is gently curved on its leading edge, so as not to damage the recorded surface, but it has a sharp, narrow, vertical trailing edge.

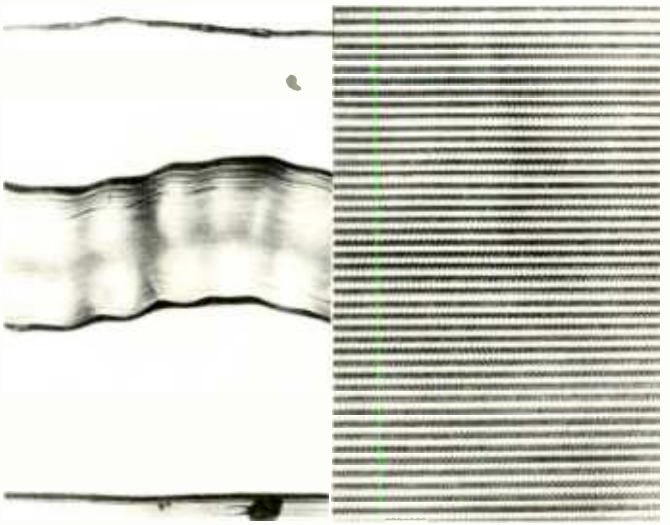
The diagram shows the stylus in contact with several complete cycles of the hill-and-dale recording, and at first impression it is not at all clear how the groove information is detected. The important point to remember is that the pickup is *pressure* sensitive; the stylus compresses the several peaks under its leading edge. The stylus loading is relatively constant with respect to time but has an alternating component superimposed upon it generated at the "sharp" edge of the stylus as each of the peaks is relieved of pressure at the trailing edge of the stylus. It is this pressure change which is conveyed to the piezoelectric-ceramic unit and is then transformed into an electrical waveform. The dimensions of the stylus itself are chosen so that no mechanical resonances appear within the frequency range of the unit, which would otherwise restrict its response. The size of the ceramic transducer is less than .008 in (0.2 mm), and the tracking force of the stylus is about 0.02 gram.

The pickup head is attached to a small tube by means of a flexible connecting layer and the tube is coupled with damping material to the traverse drive mechanism (Fig. 3).

In common with other wide-band modulation systems,



Both video and sound signals are in the extremely fine grooves of the video disc. The thin and flexible PVC foil used appears flimsy, but is actually quite tough and is said to be able to withstand 1000 playings without damage. Disc is driven by a high-speed keyed center spindle; remainder floats on air cushion.



Photomicrograph of grooves in standard long-play audio record (left) compared to much higher density grooves of video disc. Using vertical (hill-and-dale) recording, the video disc has between 3300 and 3800 grooves per inch while the conventional audio record may contain only about 250 to 350 grooves per inch.

Teldec uses FM signals for recording. This enables the band-width of some 16 octaves to be accommodated at an acceptable signal-to-noise ratio. It also means that all portions of the recorded waveform are limited to the same amplitude and thus the groove spacing can be held constant with virtually zero clearance between adjacent groove walls. With lateral-type disc recording there must be a relatively large clearance between adjacent grooves to allow large amplitudes to be accommodated or, alternatively, a variable groove-spacing technique adopted to allow greater spacing during high-amplitude parts of the recording. The constant groove-spacing also allows greater economy of recording medium usage because of the small "land" (between-groove) areas.

The *Teldec* system is only one of several which are now available, or shortly will be, for playing television recordings. First there was the video tape recorder using magnetic tape of which there are now many versions, including both reel-to-reel and cassette types. The *CBS* Electronic Video Recorder (EVR) uses an optical film made by electronic beam recording and reproduced by a flying-spot scanner. *RCA's* SelectaVision uses a holographic plastic film scanned by a vidicon for playback.

(Continued on page 60)

International Telecommunications Organizations

And How They Affect You

By RICHARD G. GOULD
formerly Executive Office of the President
Office of Telecommunications Policy*

The ITU, IFRB, CCITT, and CCIR—what do they mean? And what do they do? Solving international telecommunications problems successfully during the past 100 years has been the achievement of groups like these.

"Region 2: 470-890 MHz, Broadcasting. Note: In Region 2 the band 608-614 MHz is reserved exclusively for the Radio Astronomy service until the first Administrative Radio Conference after 1 January 1974 which is competent to review this provision, however, this provision does not apply to Cuba."

THOSE words constitute a small portion of Section IV of the "Radio Regulations." What are the regulations? Where do they come from? What's an Administrative Conference and why doesn't Cuba use the same radio astronomy band as the other Western Hemisphere countries?

Let's start at the beginning. One of the first—if not *the* first—international organization was the International Telegraph Union, founded in 1865 by a group of European countries. The first American to participate was a representative of *Western Union* who went to a conference in Berlin in 1885. As the technology changed, the scope and membership of the organization changed with it. Now known as the International Telecommunication Union (ITU), it has some 134 member countries. They range from Upper Volta with its some 1300 telephones to the United States with approximately 110 million.

The latest charter of the ITU is in the International Telecommunication Convention that was adopted in Montreux, Switzerland in 1965. The United States signed the Convention and it was later ratified by the President with the advice and consent of the Senate. It is an international treaty to which the United States is bound.

The Convention, among other things, sets up provisions for Administrative Conferences (that is, conferences of governments), a Secretariat for the ITU, the International Frequency Registration Board (IFRB), and two consultative committees: the CCITT for telephone and telegraph and the CCIR for radio (Fig. 1).

In recent years, conferences have been held every seven or eight years. The last one that dealt with space services was held in 1963. The next one, the WARC, is scheduled for 1971. The most important function of Administrative Conferences is to revise the Radio and Telephone Regulations. These regulations are also treaties to which the U.S. is bound, following ratification.

Radio and Telephone Regulations

The Regulations contain many things. First, they define services. Every radio station operates in a specific service. Some of these are the Standard Frequency Service, the Aeronautical Mobile Service, and so on. Here is the definition of the Broadcasting Service that was mentioned at the beginning of the article:

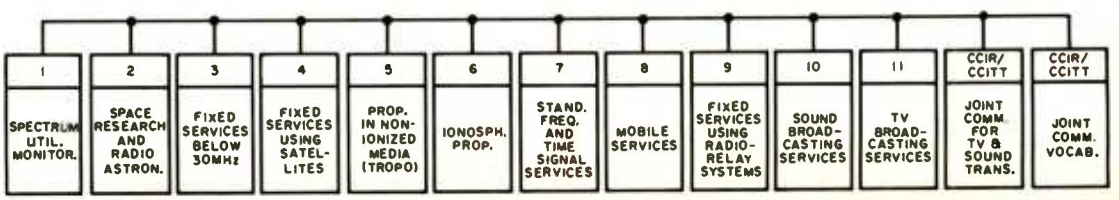
"A radio communication service in which the transmissions are intended for direct reception by the general public. This service may include sound transmissions, television transmissions, or other types of transmissions."

You can see from this definition that a communications satellite, like Early Bird, carrying television programs from one country to another where they are later sent to local broadcasting stations is not operating in the Broadcasting Service. It may not use frequencies intended for that service. It must use those allocated to the Communications-Satellite Service.

The most favorable allocations a service can obtain are exclusive and "Primary" or "Permitted." Stations in such services have essentially equal rights in a band. Next is "Secondary" service, stations in which may not cause harmful interference *to* stations in a Primary or Permitted service already operating in the band—or which may operate there later. Also, they may not claim protection *from* interference caused by stations in the Primary or Permitted services—either now or in the future. They may only claim protection against interference caused by other Secondary users.

Allocations can be either world-wide or by regions (Fig. 2). Region 1 includes Europe and Africa, Region 2 is the Western Hemisphere, and Region 3 is essentially Asia and Australasia.

Fig. 1. Organization chart showing study groups that make up the Consultative Committee for International Radio.



Going back to the band mentioned at the beginning (470-890 MHz), only a 12-MHz portion of it is exclusively for broadcasting throughout the world. Other portions are shared with Radionavigation and Fixed Services in Region 1, while still other portions are used for Radionavigation and shared with Fixed and Mobile Services in Region 3.

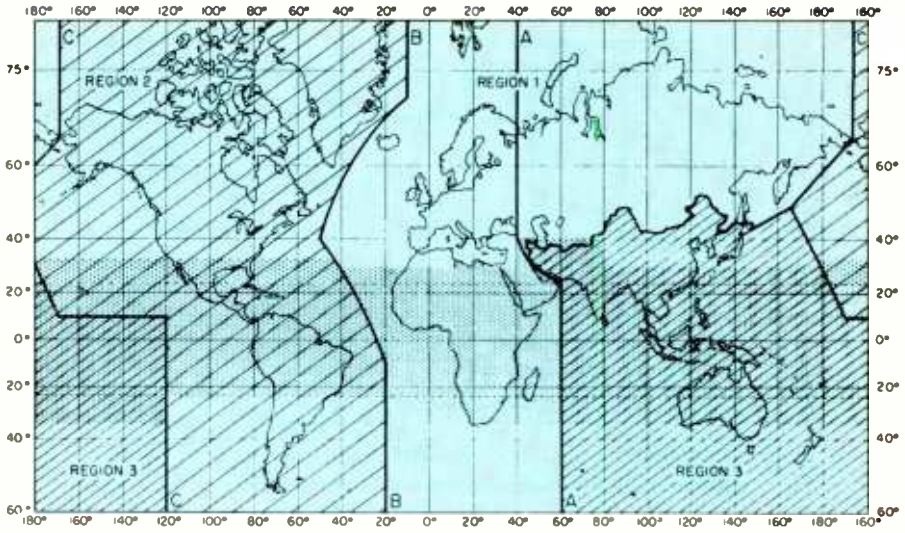


Fig. 2. Chart of regions as defined in table of frequency allocations. Region 1 (B-B) includes Europe and Africa; Region 2 (C-C) Western Hemisphere; and Region 3 (A-A) essentially Asia and Australasia. The shaded part represents the tropical zone.

Satellite Broadcasting

There is even one service that has been defined, but which has no frequencies allocated to it. That is the Broadcasting-Satellite Service. This question will come up at the 1971 WARC but it is going to be difficult to shoehorn this new service into the structure of current allocations. Technically, the best solution would be to give it an exclusive allocation, so the high power of these satellites would not cause interference to other services. However, there are no unallocated bands left below 40 GHz. An exclusive allocation would mean taking frequencies away from some other service. Alternatively, this service could share a band with another service. But which one? If it is shared with v.h.f. or u.h.f. TV stations in the Broadcasting Service (Fig. 3), the satellite couldn't be received in areas where there are nearby broadcasting stations on the same frequency. Moreover, it would knock out TV reception in the fringe areas of existing TV stations.

One possibility might be to clear a few channels in the u.h.f.-TV broadcast band exclusively for Satellite Broadcasting. Between channels 63 and 83 there is only one station operating in the U.S. However, Construction Permits have been issued for stations on seven of those channels, one has an application pending, but 12 others are completely free. That might work in the U.S., but not necessarily in other parts of the world where these frequencies are allocated to other services.

Another possibility would be to share frequencies with radio-relay systems, the way communications satellites now share those same frequencies. However, the higher power of broadcasting satellites would probably cause interference. Another possibility would be to set aside an exclusive portion of one of the bands around 11 GHz for space broadcasting. That would mean changing frequencies of the Fixed and Mobile Services now using those bands because they couldn't tolerate the higher power from the satellite either. The biggest drawback of that band, as far as broadcasting is concerned, is there are no TV sets that can receive those frequencies. Anybody who wanted to receive the satellite would have to use a new antenna and a converter to feed into a v.h.f. or u.h.f. channel on his set. If the satellite used wide-deviation FM to save transmitter power, the converter would have to change the modulation to VSB-AM, the modulation for which conventional receivers are designed.

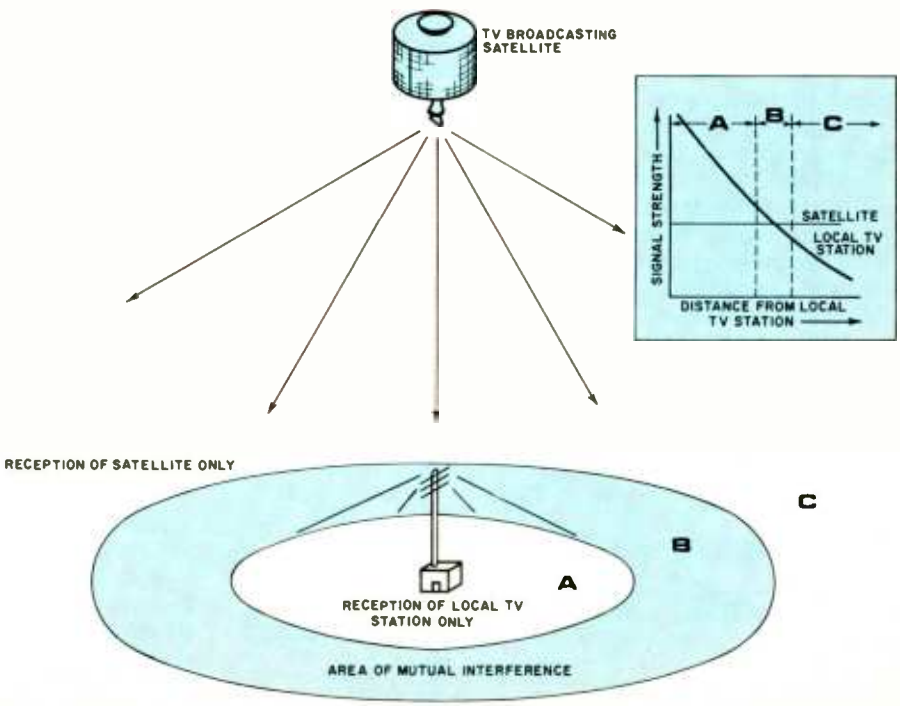
The Radio Regulations also prescribe rules for particular services. For example, one rule for the Communications-Satellite Service says that, in the bands shared with fixed or mobile services, an emission from a satellite shall not exceed −130 dB above one watt per square meter (dBW/m²) and that the power in any 4-kHz band may not exceed −152 dBW/m². Where do these Administrative Conferences get their technical inputs to establish rules like that?

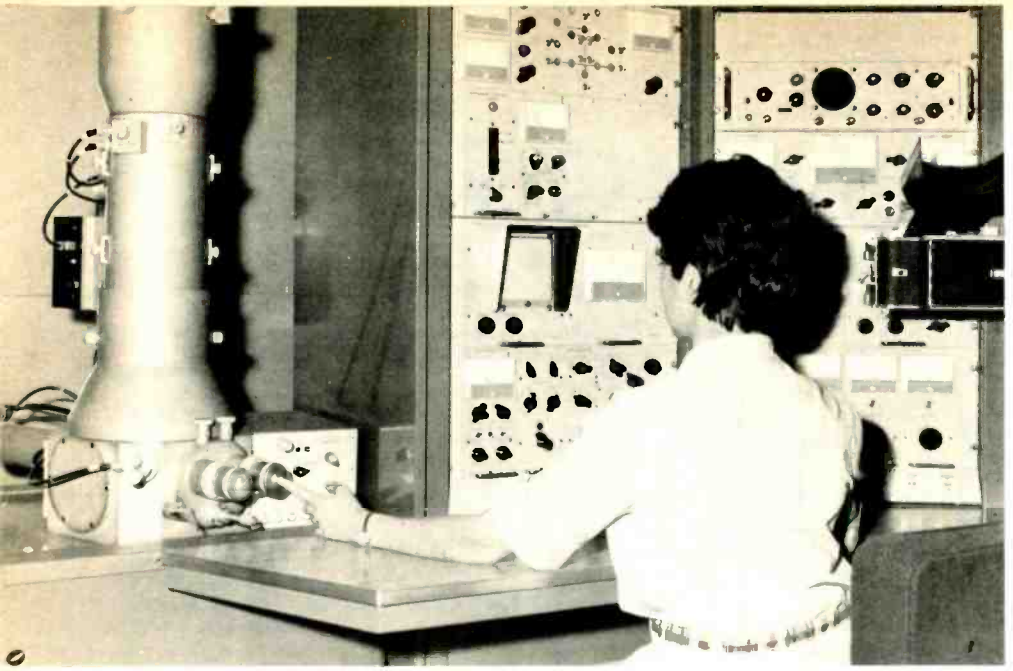
Technical Inputs

The largest single source is the Recommendations of the CCIR and the CCITT. The CCIR meets in Plenary (full) assembly every three years. Interim meetings are held almost every year. The CCIR is at the present time composed of some 13 study groups. Study Group 4, for example, is concerned with space systems; Study Group 11 with television broadcasting; and Study Group 9 is concerned with radio-relay systems.

The CCITT has 16 study groups, several special groups, eight joint working parties, and two joint groups with the CCIR for TV and sound signals. In addition to being inter-

Fig. 3. Diagram and graph depicting interference patterns experienced between TV broadcasting satellites and local TV stations.





Using an SEM manufactured by Cambridge Scientific Instruments.

Scanning

DURING the 1920's, physicists discovered that electrons have wave characteristics similar to those of ordinary light. Furthermore, they found that high-energy electrons have wavelengths at least a hundred times shorter than visible light. Since the magnifying power of a microscope is inversely proportional to the wavelength of the illuminating medium, physicists and engineers quickly caught onto the idea of building microscopes that would use an electron beam, rather than light, as the source of illumination. Such microscopes, they reasoned, would have magnifying powers far beyond those of any optical microscopes. The first workable electron microscopes were tested in 1932 and *RCA* marketed the first commercial versions in 1940.

The first electron microscopes were of the *transmission type*. The electron beam had to pass completely through the specimen before an enlarged image could be focused onto a small viewing screen or photographic plate below. In 1938, several groups of scientists and engineers attempted to construct a scanning electron microscope—one that scanned the specimen with the electron beam and detected reflected electrons rather than transmitted ones. The main reasons for this new approach were to do away with the need for using very thin specimens and to eliminate many time-consuming operations involved in preparing the specimen.

Electronics in the late 1930's, however, was not ready for scanning electron microscopes (SEM's). Photomultiplier detectors were inefficient, amplifiers were too unstable and noisy, and cathode-ray tubes had to wait for later refinements which came as a result of World War II research.

By the time it was possible to build an effective scanning electron microscope, the transmission types were firmly established both in the marketplace and in the minds of scientists. Most scientists thought the scanning electron microscope might one day become a useful secondary tool, but they believed nothing could ever replace transmission electron microscopes (TEM's). Because of this attitude, there weren't many customers when *Westinghouse* tried to market the first commercial scanning electron microscopes in the early 1960's.

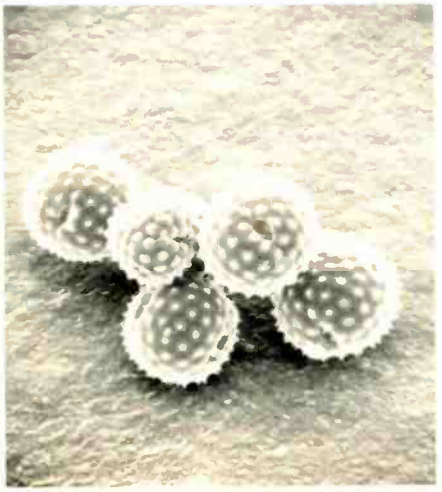
Since 1964, though, the developments and applications of scanning electron microscopes have been growing every year. Scientists who have scanning electron microscopes in their labs now seem to think the SEM is the closest thing to an ultimate microscope yet invented, and a good many scientists who don't have one wish they did. With this change of attitude, it is quite possible that the scanning electron microscope will make conventional transmission electron microscopes a secondary lab tool by the end of the 1970's.

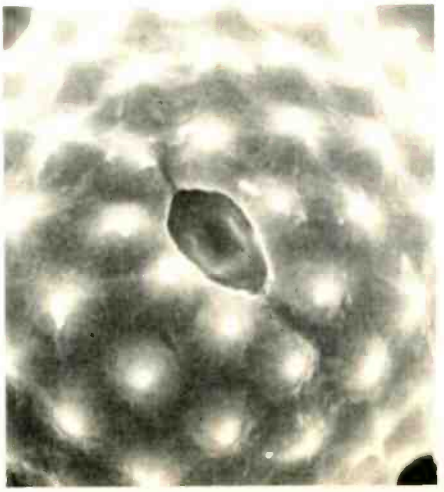
Some Unique Applications

An elaborate arrangement of finely calibrated positioning knobs makes it possible to move the specimen around while observing the SEM display. Thus, it is possible to photograph the image in one position, tilt the specimen to one side a bit, and photograph the image again. The result is a stereoscopic pair of photos that add the valuable dimension of depth to SEM investigations.

Aside from the usual functions of a microscope—making enlarged images of tiny objects—the SEM has some other unique potential applications. For example, the electron beam used can interact with charge carriers in semiconductor materials. So, if the specimen happens to be a transistor or a microcircuit, it is possible to see charged or current-carrying segments of the chip sharply contrasted against the neutral portions. This feature makes the SEM a popular new tool for use

SEM photomicrographs of ragweed pollen at 1000X (left) and 5000X (right). Operator can zoom in on a specimen without having to refocus the electron beam. All photomicrographs were made for us by Battelle Memorial Institute, Columbus, O.





Electron Microscopes

By DAVID L. HEISERMAN

Doing away with the need for very thin specimens and eliminating time-consuming preparations, these microscopes provide extremely high magnification.

in semiconductor research and development laboratories.

Researchers using TEM's have to take elaborate steps to prepare a specimen for viewing and, sometimes, they even have to make replicas of the microscopic objects they want to observe. Such preparations make it impossible to view living biological tissues. With an SEM, such drastic steps aren't usually necessary. This SEM feature, combined with their lower beam currents, makes it possible to observe living biological tissues for a short period of time. In the near future scientists hope to use the SEM to directly observe the electrical activity of living nerve cells.

The SEM can also be operated backward to reduce images. Connecting a photocell and amplifier unit to the SEM blanking coil makes it possible to modulate the electron beam on the specimen stage with light from an external source. By placing a black-and-white transparency between the photocell and the display CRT, for instance, the operator can make 20,000:1 reductions of the transparency on the specimen stage. One SEM technologist claims he can place a small piece of soft metal onto the specimen stage and electron-etch every page of a book onto it. Perhaps he could fit the contents of the Library of Congress into a conventional file cabinet with this technique. Of course he would have to use the SEM as a magnifier whenever he wanted to read or copy any of the pages at a later time.

How it Works

The only resemblance between a scanning electron microscope and an ordinary optical microscope is a functional one—they both make large images of tiny objects. Unlike optical microscopes, SEM's illuminate the specimen with an electron beam. Unlike transmission electron microscopes, the electron beam in an SEM scans across the specimen producing a television-like raster.

TEM's can display real-time images only on a tiny fluorescent screen. This image is generally useful only for lining up the specimen and adjusting the microscope electronics. So, most investigations with a TEM have to be carried out by means of electron-exposed photographs. SEM's, on the other hand, use a sweep generator to scan the specimen with the electron beam and, at the same time, build up a raster on a conventional CRT display. As the electron beam in the SEM strikes dense portions of the specimen, secondary and backscattered electrons bounce away to an electron detector. This video output from the SEM electron detector intensity-modulates a CRT, creating a real-time, TV-like image of the specimen.

The magnifying power of an SEM is the ratio of the length of one CRT display scan to the length of one microscope beam scan. If the CRT display scan is four inches long, for example, and the electron beam in the microscope scans across a .0004-inch segment of the specimen, the effective magnifying power of the system is 10,000X. By reducing the microscope beam scan to 0.0002 inch and keeping the CRT scan the same, the effective magnifying power becomes 20,000X.

A scanning electron microscope has four basic sections

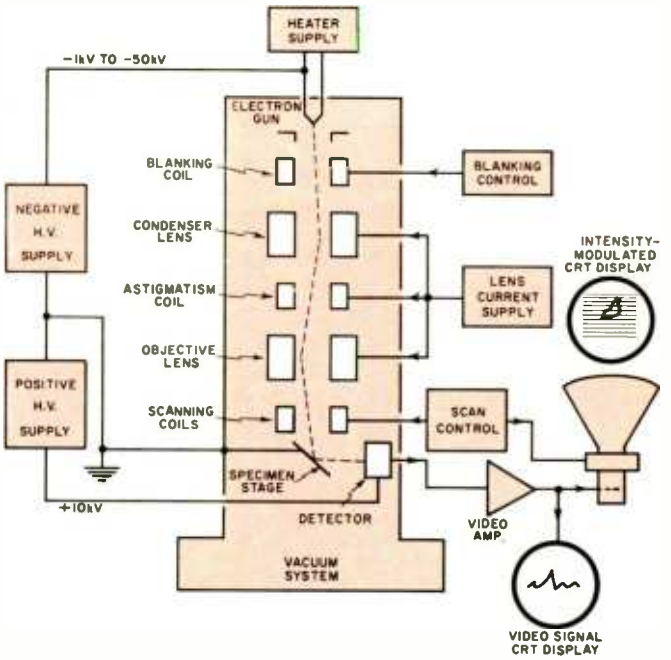
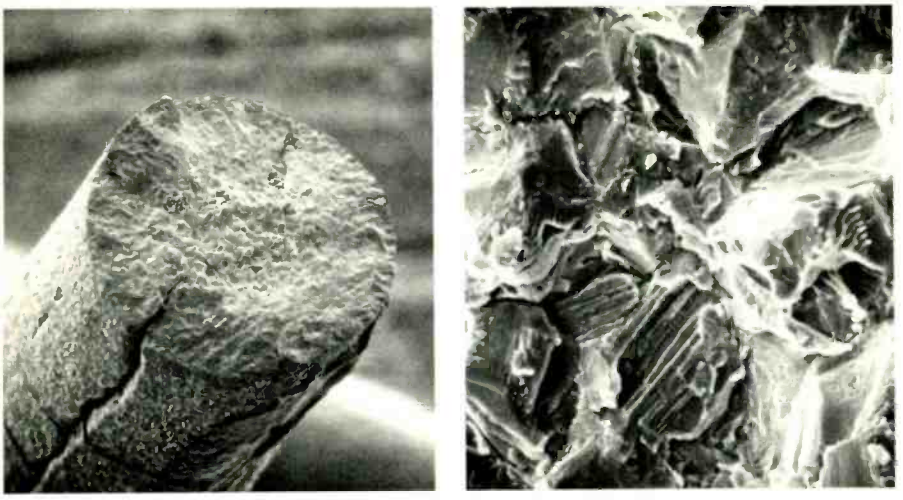


Fig. 1. Block diagram of a typical scanning electron microscope.

Table 1. Some typical scanning electronic microscope specs.

Resolution	200 angstroms
Magnification	X10 to X50,000
Electron-gun voltage	1 kV to 30 kV
Scintillator voltage	12 kV
Electrical service requirements	240 V single-phase, 50/60 Hz, 5 kVA



SEM photomicrograph showing stress corrosion fracture in titanium alloy wire (left). Magnification is only 100X; however, photos of opaque objects are not possible with conventional electron microscope. A 2000X enlarged photomicrograph (right) shows the metallurgical structure of end of wire.

that blend state-of-the-art techniques from both mechanical and electronic engineering.

1. An electron-optical column that shapes the beam and sweeps it across the specimen.
2. A vacuum system that pulls the number of air molecules in the electron-optical column down to a minimum.
3. A detector system capable of picking up several different kinds of radiation from the specimen.
4. A display system that presents different kinds of information for direct viewing or recording on film or magnetic tape.

The electron gun in an SEM is much like the gun in a conventional CRT (Fig. 1). The directly heated tungsten cathode is connected to the negative terminal of an adjustable, highly regulated, high-voltage d.c. power supply. This power supply drives the cathode to between 1 kV and 50 kV negative with respect to the grounded specimen stage. The SEM operator can adjust the high-voltage supply to obtain the desired electron beam energy level.

The condenser lens does just what its name implies—it condenses the relatively thick stream of electrons from the electron gun into a fine, dense beam. The objective lens further condenses or "demagnifies" the beam. Although the term "focus" might seem appropriate here, an SEM does not focus the electron beam to a fine point as a glass lens focuses light. The superior depth of field that characterizes an SEM, in fact, is due to electrons traveling in nearly parallel paths instead of converging paths that meet at one tiny, two-dimensional point. Because of the electromagnetic lenses in the SEM, the electron beam has a diameter of only about 20 microns (millionths of a meter, μm) when it leaves the gun, and a diameter of only about 0.01 micron when it reaches the specimen stage.

Adjustable constant-current power supplies deliver highly regulated currents—usually in the neighborhood of 100 to 7000 milliamperes—to the lens coils. The operator can adjust the current to each coil independently to optimize the demagnification and amount of bend in the beam.

A set of scanning coils, much like those in the yoke of a television receiver, sweep the electron beam across the specimen. Unlike a TV receiver, however, the SEM operator has complete control over the scan rate and the number of lines in a display frame.

Most SEM's also contain a set of astigmatism and blanking coils. The astigmatism coil insures that the electron beam maintains a uniform diameter at all points on the specimen stage. The blanking coil, generally used only for special SEM applications, can turn off the electron beam upon commands from either the operator or an electronic timing circuit.

Electron Detectors & Displays

The SEM operator often has a choice of detecting several different kinds of energy emitted from the bombarded specimen. He can detect weak x-rays or cathodeluminescence with the appropriate detectors. He can also use other detectors to sense absorbed or transmitted electrons.

By far the most common kind of SEM detector, however, is one that detects both secondary and backscattered electrons from the specimen. This kind of electron detector is made up of a Faraday cup, a semiconductor scintillation element, and a length of flexible light pipe (Fig. 2).

The Faraday cup is an aluminized cup a bit over an inch in diameter. A metal screen or grid covers the open end of the cup and the entire assembly is usually charged with a +200-volt accelerating potential.

The scintillator element is attached to the bottom of the Faraday cup, but electrically insulated from it. The positive section of the SEM high-voltage supply feeds about +10 kV to the scintillator.

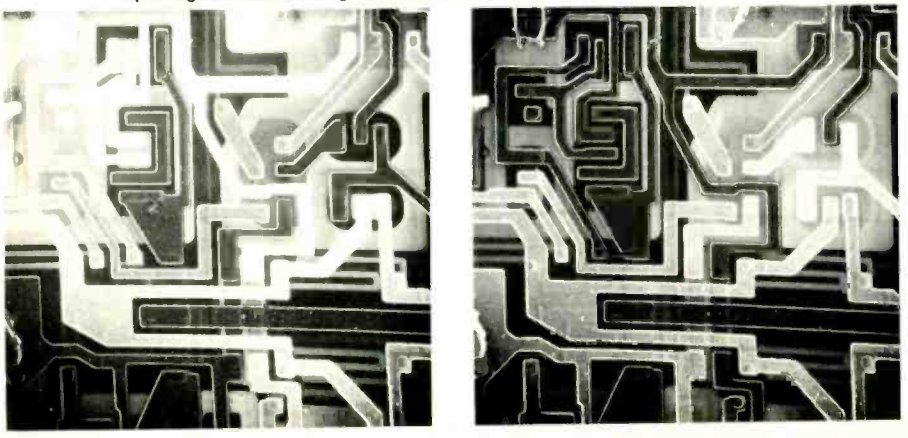
The scintillator element is made up of a light-emitting semiconductor material. Whenever electrons reflected from the specimen strike the scintillator with sufficient energy, they create an unstable electron-hole pair in the semiconductor material. When these unstable charges recombine, they dissipate their excess energy in the form of light.

The light pipe, connected to the back of the scintillator element, carries the weak light energy away from the Faraday cup to a photomultiplier. The photomultiplier changes this light energy into electrical signals for use by the display devices.

The basic SEM package generally includes three CRT's. One displays the video signal from the multiplier and is

(Continued on page 52)

These two 200X SEM photomicrographs, taken at Battelle Memorial Institute, show a JK flip-flop IC in action. One photo shows the circuit in one state and the other shows the circuit in the opposite state. The current-carrying conductors in IC actually interact with the electron beam of the microscope; conductors with the higher potentials show up in lighter shades of gray. Note voltage gradients along some paths.



Electronic Security Systems

Police cannot combat rising crime rates unaided. People must use electronic devices to protect lives and property.

By **John Frye**

BARNEY was sitting on the service bench reading a newspaper when Mac, his employer, came through the swinging door from the front office.

"Good morning," he said, tossing the paper over to Mac. "I see burglars hit three more houses last night. They cleaned out two homes whose owners were on vacation in Florida. At the third house the folks were home; and when the elderly owner went downstairs to investigate, the burglars struck him over the head. He's in critical condition in the hospital with a brain concussion. Do I imagine it, or is crime getting worse?"

"You don't imagine it," Mac answered. "According to a Uniform Crime Report prepared by the FBI and released in August, 1970, total crimes per 100,000 population in this country rose 120% from 1960 to 1969. In the same period the violent crime rate shot up 104%. That includes murder, forcible rape, robbery, and aggravated assault. Auto theft rate went up 138%. Note these figures take into account the 13% increase in population during this nine-year span; so those head-in-the-sand optimists who say crime is simply keeping pace with increasing population are indulging in wishful thinking."

"Our police departments aren't geared to a crime increase of that size."

"No, and they need help. I hasten to say I'm not talking about vigilante organizations that have a way of starting out being protective and end up being punitive. I mean we ordinary citizens should do all in our power to make crime difficult and unrewarding."

"Are you talking about burglar alarms?"

"That's too restrictive and narrow a term. I'm talking about all sorts of crime-deterrent devices, from locks on the doors—which Norman Eisenstat of *Defensive Instruments* says constitutes the sole security device in more than 99% of the homes in this country—to the most sophisticated combination of perimeter and space-age electronics security systems."

"Sounds like we've been making it too easy for the criminals. What's being done to change all that?"

"Business especially is declaring all-out war on shoplifters and burglars. Saul Astor, president of *Management Safeguards*, prophesies the tide of crime in American business will begin to turn in 1971. In 1967 $200 million were spent on security protection. This was up to $500 million last year. At least a billion dollars annually is expected to be spent by 1975. Interesting to us is the fact that a *Motorola* consultant estimates 80% of 1970's security expenditure went for electronic equipment and 90% of that billion-dollar figure will go into our field."

"Where is most of this stuff used?"

"The military has been a major customer, but that market is falling off. Offices, schools, banks, department stores, factories and big industrial complexes buy most of the rest of it. In fact, insurance regulations make such equipment mandatory in many of these places. But the industrial purchases cannot begin to take up the slack of the market being lost as military purchasing is cut back. Security equipment manufacturers are casting about—some rather desperately—in search of new markets."

"And the American home looks like a good prospect, I suppose."

"You suppose right. C. S. Moorefield, president of *MRL, Inc.* Falls Church, Virginia, thinks the recent Court of Appeals decision holding landlords responsible for the physical security of tenants is bound to have a profound effect on the industry. The bizarre multiple murders out in California last year made many people fear for their safety in their homes. Robert Williams, vice president of *Acron Corp.*, thinks senior citizens should not be neglected in the flourishing security market simply because many are of modest means. He points out that these people are more vulnerable and consequently far more apprehensive about sudden illness, encounter, and confrontation, as well as the potential hazards of fire, than are the young and able-bodied."

"Some homes already have security protection," Barney pointed out.

"That's right. But most of them are of the more expensive type. *Westinghouse* is moving into the non-military security market, and William Casey, president of the consumer-oriented *Westinghouse Security Systems, Inc.*, admits that right now they are concentrating on the top 5% of the residential market—homes costing over $50,000. But he admits this is a limited market because the average system costs $1600 plus a $10 to $15 a month service contract. In 3 months though they intend to introduce a system that costs $900 and in a little over a year will come out with one that virtually any homeowner can afford. He thinks within ten years one home in four costing $40,000 will contain built-in protection devices.

"Pierre LaBarge, Jr., chairman of *LaBarge Electronics*, which has been producing equipment for the military in Viet Nam, says, 'We hope to gravitate into the home market, also into personal defense.' John Thomas, vice president of *Robotguard, Inc.*, feels the big market will be in small business and residential homes. Mr. Eisenstat, whom I mentioned before, thinks that within three years low-cost security systems will be sold in mass merchandising outlets, with department stores having security boutiques."

"What forms do these systems take?"

"The perimeter type is the familiar electro-mechanical one that surrounds the house with security by having some form of switch on every window and door. Opening any window or door changes the switch and sounds an alarm which alerts the homeowner, the neighbors, and possibly the police department. Best of all, it frightens off the burglar. Such a system consists of: (1) a central control box containing a key switch to turn the system on and off, batteries, and an alarm bell, horn, or siren; (2) another alarm that can be heard outside the house; and (3) some form of mechanically operated, magnetic reed, vibration, or pressure switch on every window or door of the house. If a.c. power to the house is cut off, the system automatically switches over to batteries. A delay on the key-switch controlling the perimeter system permits the householder to activate it and leave

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or enter and deactivate it without tripping the alarm—providing both are done with reasonable alacrity.

"Perimeter system components are not costly, but the system is expensive to install because practically every room in the house must be wired. The fact that the entire house *is* wired, on the other hand, permits the easy addition of fire-sensors and panic buttons."

"Hold it!," Barney interrupted. "I savvy fire-sensors. They are simply heat-sensitive switches that are thrown when ambient temperature rises above 135° F (or above 190° F for special installations near the furnace, etc.) but are you joking about 'panic buttons'?"

"Not at all. These are simply push-button switches located in strategic locations around the house that sound the alarms, both internal and external, when pushed, even though the perimeter alarm system has been deactivated. This permits the householder to summon help when confronted by an intruder, or when becoming ill."

"I know about photoelectric systems," Barney offered. "They all operate on the same principle: a beam of light shines on a photocell. Interrupting the beam of light sounds an alarm. With the old incandescent beam of light, the burglar could actually see the beam and 'fool' the system by simply holding the ray from his flashlight on the photocell as he passed through the alarm beam. He can't do this with modern light sources that include infrared, ultraviolet, modulated light, and even laser beams. A few systems are using the IR light-emitting diodes for low-current light sources. A photoelectric system works well for protecting a single, small area or a single entrance, but it is not too practical for protecting an entire house with many windows and doors."

"Right you are!," Mac agreed, "and the same thing is true to a certain extent with space-age systems using radar, ultrasonics, or microwaves. All these operate on the Doppler effect. The ultrasonic system is typical of the others. A piezoelectric transducer floods an area with ultrasonic waves that are reflected from stationary objects into a piezoelectric receiver. Any moving object in the covered area causes changes in frequency, amplitude, and phase of the received signal, and a detector/reference circuit detects this difference and triggers an alarm. Manufacturers of microwave and ultrasonic alarms include *Delta Products, Euphonics, Mallory,* and *Radar Devices.*

"This is the easiest system of all to install because all you do is unpack the combination transmitter/receiver and plug it in. Low-powered units will cover a 15' by 15' area while higher-powered units will double the covered diameter. Often a corridor as long as a hundred feet or better can be covered by a single unit. Unfortunately all three types have to be guarded against false alarms. Radar and microwave types penetrate walls and can be tripped by moving objects outside the house. Air turbulence caused by a furnace or air conditioning can trip Doppler-principle systems if filters are not built into them to take care of this hypersensitivity. In general, electronic systems are more subject to the weakness of *Aesop*'s original alarm system: the shepherd boy who was supposed to keep the wolves from the sheep. They tend to cry 'wolf!' when no wolf is present."

"You can't connect heat-sensors and panic buttons to photoelectric or ultrasonic systems, either," Barney pointed out. "It seems to me the best system would be one using a perimeter system backed up by photoelectic and/or space-age systems. Are there any other systems?"

"There's closed-circuit TV," Mac pointed out. "This is used chiefly in stores and other business places at present. Coupled with a VTR unit, it can provide the store manager with a photographic record of a shoplifter in action—evidence hard to refute. I'm sure CCTV is going to move into the home quite rapidly as the cost of solid-state cameras comes down.

"*Aerojet Delft Corp.* manufactures a night-vision security device and forecasts a mushrooming market for light-intensification products. They say only a small percentage of our 40,000 police departments have such devices now but they expect every one of these departments to have some sort of such device within two years.

"Both *James Electronics* and *GC Audiotex* manufacture auto alarm systems whose alarms are triggered by any sudden drop in battery voltage such as that caused by turning on the ignition, or opening the hood, doors, or trunk; yet the alarms are not triggered by the winding of the electric clock.

"*Entron, Inc.* is out with a system called Intrudalarm designed to be used with a CATV system affording two-way communications transmission—something still to come but almost certainly on the way.

"If we are going to have to go back to living in our castles surrounded by an electronic moat, we can," Mac concluded; "and as electronics technicians it is rather comforting to be reminded by Walter Strobl, vice president of *Guardsmark, Inc.* that 'protection services will have to provide better-trained and more technically proficient personnel to complement these electronic aids and to act decisively in the event of alarm activation malfunction or failure.' We can be paid well for making crime pay poorly for the criminals." ▲

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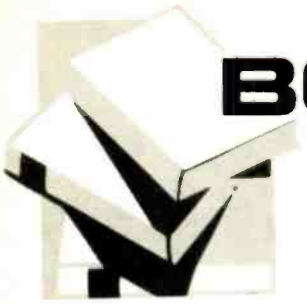

BOOKS

"INTRODUCTION TO ELECTRIC CIRCUITS" by H. Alex Romanowitz. Published by *John Wiley & Sons, Inc.*, New York. 615 pages. Price $11.95.

This volume is designed as a classroom text for technical schools or freshman engineering courses. A working knowledge of simple algebra is prerequisite and an understanding of trigonometry is useful.

The text material is divided into 25 chapters covering electrical basics, direct-current meters and instruments, inductance, capacitance, alternating current and voltage, phasors, parallel and series-parallel a.c. circuits, power and energy in a.c. circuits, a.c. current meters and measurements, the network theorem, resonance, coupled circuits, power transformers, polyphase systems, nonsinusoidal waves, and motors and generators.

Each of the well-illustrated chapters is followed by review questions and problems to be solved. Answers to approximately half of the questions are given in the back of the book. An instructor's manual to be used with this text is also available.

* * *

"SEMICONDUCTOR PULSE CIRCUITS" by Brinton B. Mitchell. Published by *Holt, Rinehart and Winston, Inc.*, New York, N.Y. 374 pages. Price $10.50.

This is a handbook for technicians with emphasis on the acquisition of technical proficiency in the repair, modification, testing, and building of semiconductor pulse circuits. With this goal in mind, the author has included experiments involving a design circuit problem or an analysis circuit problem. The twenty chapters each offer a typical basic circuit and is followed by prerequisite theory, a design example, a circuit analysis example, the experiment, and then questions covering the material.

Almost all of the laboratory equipment required to perform the experiments is to be found in a typical service shop so there is no reason why this volume couldn't be used by a practicing technician to upgrade his skills. The only prerequisites are a firm grasp of d.c. and a.c. circuit theory, basic circuit theorems and associated mathematics, and semiconductor theory. Typical semiconductor spec sheets are included, making this volume complete in itself.

* * *

"LABORATORY MANUAL" sponsored by Wentworth Institute of Boston under a grant from National Science Foundation. Published by *Prentice-Hall, Inc.*, Englewood Cliffs, N.J. Four volumes. Price $7.95 each. Soft cover.

These volumes are part of a new series of laboratory manuals designed for the training and upgrading of electronics technicians.

Included in this series are manuals for electronic shop practices, electronic instrumentation, transistor and semiconductor devices, and electric circuits. Heavy emphasis is placed on the taking of data, the organization and correlation of the data so that conclusions can be reached, the display of data on graphs, and the presentation of a report. This is in line with industrial methods and prepares the student for immediate absorption into actual job situations.

It goes without saying that emphasis throughout this series is on practicality and the no-nonsense approach permits the student to work at his own pace and develop the self-discipline needed on a job.

* * *

"SECURITY ELECTRONICS" by John E. Cunningham. Published by *Howard W. Sams & Co., Inc.*, Indianapolis, Ind. 154 pages. Price $4.50. Soft cover.

This volume is designed to assist prospective users pick a system that best meets their security requirements and aid electronics technicians who install it.

Various types of intrusion alarms and intrusion-detection systems are described along with details on basic operating principles, installation hints, and schematics. Photographs of commercial units representing the various types are also included, but, unfortunately, the author has not provided a directory of manufacturers to whom the reader could apply for additional details.

The text is divided into 13 chapters and an appendix covering integrated-circuit applications in the security field. The material is presented in clear, concise, easy-to-read form and should be helpful to those in security electronics.

* * *

"DIRECT TRANSISTOR SUBSTITUTION HANDBOOK" by H.A. Middleton. Published by *Hayden Book Company, Inc.*, New York. 224 pages. Price $2.95. Soft cover.

Technicians confronted by a piece of transistorized equipment, a bad transistor, and no direct replacement handy, will find this handbook useful. It lists substitutes for nearly 12,000 transistors—providing 130,000 alternatives, graded on the basis of "best" substitute, "next best," and "good." These substitutes have been computer-selected on the basis of major electrical and physical properties. Conservative tolerances were placed on the transistor characteristics used for comparison. A section on base codes and a chart of lead arrangements are also included to permit checking on direct interchangeability.

This handy manual is small enough to be slipped into a technician's caddy to accompany him on service calls.

* * *

"SHORT-WAVE LISTENER'S GUIDE" by H. Charles Woodruff and **"NORTH AMERICAN RADIO-TV STATION GUIDE"** by Vane A. Jones. Published by *Howard W. Sams & Co., Inc.*, Indianapolis, Ind. 104 pages & 157 pages, respectively. Price $2.95 each. Soft cover.

Here are up-to-date editions of two popular "guides" for SWL's and radio and TV fans. The short-wave guide provides a selected listing of the more dependable international short-wave stations that beam their programs to the U.S. The material is presented in four forms: by country and location within the country; by frequency; by times of broadcast; and clandestine stations in communist-controlled countries. A station log is also provided.

The station guide lists TV, AM, and FM stations by location, channel and/or frequency, and by call letters. In addition to stations in the U.S., the guide lists those in Canada, Cuba, Mexico, and the West Indies.

* * *

"TRANSISTOR SPECIFICATIONS MANUAL" compiled and published by *Howard W. Sams & Co., Inc.*, Indianapolis, Ind. 192 pages. Price $4.50. Spiral-bound soft cover.

This is the fourth printing of this handy, up-to-the-minute guide to the electrical and physical specifications on over 10,000 transistor types.

Included in the manual are polarity, maximum applied voltages, power dissipation, collector current, operating frequency, collector cut-off current, and d.c. current gain for each bipolar transistor while design frequency, power output, power gain, and collector efficiency are listed for r.f. power transistors.

All EIA-registered TO outlines are shown and for nonstandard cases, a dimensional drawing is provided in a separate section. Where known, obsolete transistors are noted and the last known manufacturer listed. ▲

Video Tape Recorder

(Continued from page 35)

will make VTR's to this standard. A listing of presently available EIAJ, Type 1 standard recorders is given in Table 3. *Ampex's* Instavision video-tape recorder/player (see Table 1), which was introduced to the press late last year (see "Recent Developments in Electronics," December, 1970 issue), will not be available until mid-1971. It is interesting to note that of the sixteen brand names that are listed in Table 1, there are only three non-Japanese manufacturers: *Ampex*, *Philips*, and *International Video Corp.* (*IVC* machines are also sold by *RCA*, *GPL*, and *Bell & Howell*).

Interchangeability

In many cases, tapes made on one brandname VTR are interchangeable with (or reproducible on) a recorder with a different brand name; this is because one manufacturer's recorders are often sold under many names. It is helpful to know which recorders are made to common standards in order to facilitate tape interchange between users. Table 4 indicates VTR's which produce interchangeable tapes. ▲

Table 4. Tapes made on a recorder in any one of the groups listed will reproduce satisfactorily on any other recorder in the same group.

A.	**½-inch tape:**	**7.5 inches per second**
Apeco VT-101		Bell & Howell 2966
Shibaden SV-700U		Shibaden SV-707
Shibaden SV-800U		(Photo C)
B.	**½-inch tape:**	**9.45 inches per second**
Craig 6401		Craig 6402
Diamond DP-1		Diamond PVS-1
Victor KV-810		Victor PKV-830
C.	**½-inch tape:**	**12 inches per second**
Concord VTR-400		Concord VTR-720
Panasonic 8100		Panasonic 8100 AD
D.	**1-inch tape:**	**6.91 inches per second**
IVC-600		IVC-800
IVC-900 (Photo D)		GPL VR-400
RCA-600		RCA-800
RCA-900		Bell & Howell 2000
Bell & Howell 2910		
E.	**1-inch tape:**	**7.5 inches per second**
Craig 6403		Diamond DP-2
Diamond DP-3		Victor KV-600
F.	**1-inch tape:**	**9.60 inches per second**
Ampex 4500		Ampex 5200
Ampex 5800		Ampex 7900
G.	**1-inch tape:**	**8.57 inches per second**
Concord 2300		Panasonic NV504

(Continued from page 44)

used to adjust the microscope electronics for optimum contrast and demagnification of the beam. A slow-phosphor CRT displays the intensity-modulated enlarged image for direct viewing. A fast-phosphor CRT displays the same intensity-modulated image for still or motion-picture photography.

Availability of SEM's

A mid-1970 estimate placed the number of operational SEM's in the entire world at less than 250. This is a rather scant number, considering the growing popularity of the instrument. The main reason for this discrepancy between supply and demand is due to the simple fact that the average cost of an SEM system is about $60,000. At a time when a slow economy makes scientific budget cutting fashionable, scientists are having a hard time convincing the money managers that they should buy a $60,000 SEM to replace the expensive TEM's they already have in the lab.

There are only a limited number of firms in the world now actively producing and marketing scanning electron microscopes (see Table 2). Conspicuously absent are the names of such giant American firms as *Westinghouse*, *GE*, and *RCA*. ▲

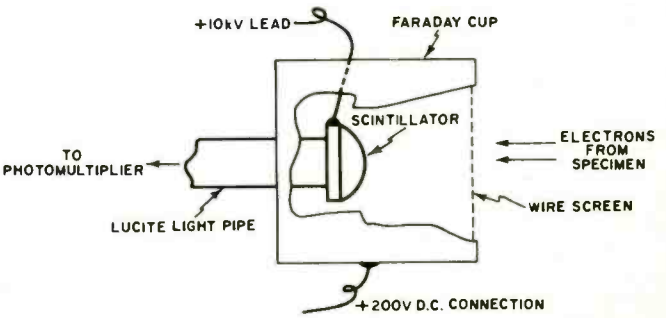

Fig. 2. In this electron detector, electrons enter the Faraday cup through a wire screen. When they strike the scintillator element, they create light-emitting electron-hole pairs. Light pipe carries the bits of light energy to photomultiplier.

Table 2. SEM manufacturers or sales representatives.

Ajay Instruments 31 Field Street Glenbrook, Conn. 06906	**Materials Analysis** 1060 E. Meadow Circle Palo Alto, Calif. 94303
Applied Research Labs P.O. Box 129 Sunland, Calif. 91040	**Micrographics** 3855 Birch Street Newport Beach, Calif. 92660
Coates and Welter 2191 Ronald Street Santa Clara, Calif. 95050	**Nuclear Diodes** Box 135 Prairie View, Ill. 60069
Forgflo Box 638 Sunbury, Pa. 17801	**Perkin-Elmer** Box 10920 Palo Alto, Calif. 94303
Jeolco U.S.A. 477 Riverside Avenue Medford, Maine 02155	**Siemens** 186 Wood Avenue Iselin, N.J. 08830
Kent Cambridge Scientific 8020 Austin Avenue Morton Grove, Ill. 60053	**Philips Electronic** 750 S. Fulton Avenue Mount Vernon, N.Y. 10550
Ultrascan 18530 S. Miles Pkwy. Cleveland, Ohio 44218	

Capacitance Calculations

(Continued from page 27)

scale. From this intersection point, a line must be drawn through an appropriate value of d. Since d was measured to be 0.015 inch, the line from the turning scale is drawn through this value on the d scale. This line intersects the C scale at a value of about 16. The maximum capacitance of the HF-15 is thus approximately 16 pF, and this calculated value agrees rather closely with the manufacturer's published maximum value of 17.5 pF.

If the two sets of plates of a given capacitor are not the same size, the diameter of the *smaller* set of plates should be used.

Note that this method will not calculate the minimum capacitance of a variable. A rule of thumb sometimes used states the minimum capacitance is about 10% of the maximum capacitance. This rule is not too accurate, but it will give a ballpark figure for capacitors with semicircular plates.

Many times a variable capacitor can be modified into a unit of smaller capacitance by having some of its plates removed. The nomogram in Fig. 2 aids in determining how many plates must be removed.

Assume that a 50-pF capacitor is to be made from a 100-pF, 10-plate unit.

First, a line must be drawn from 9 on the $N1$–1 scale through 100 on the $C1$ scale. At the intersection of this line with the turning scale, another line is drawn through the desired capacitance ($C2$=50 pF) on the $C2$ scale. This line intersects the $N2$–1 scale at about 4.5. $N2$, therefore, is 5.5. We must round this off to 6.0 in order to have at least 50 pF in the modified unit. Since only 6 plates are needed, 4 plates should be removed from the original capacitor. The six remaining plates should alternate, one on the rotating shaft, one stationary, etc. and air space between adjacent plates should be the same as the original. ▲

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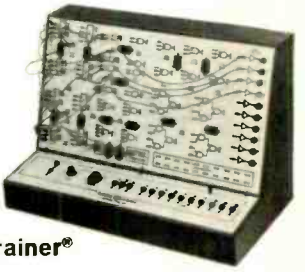

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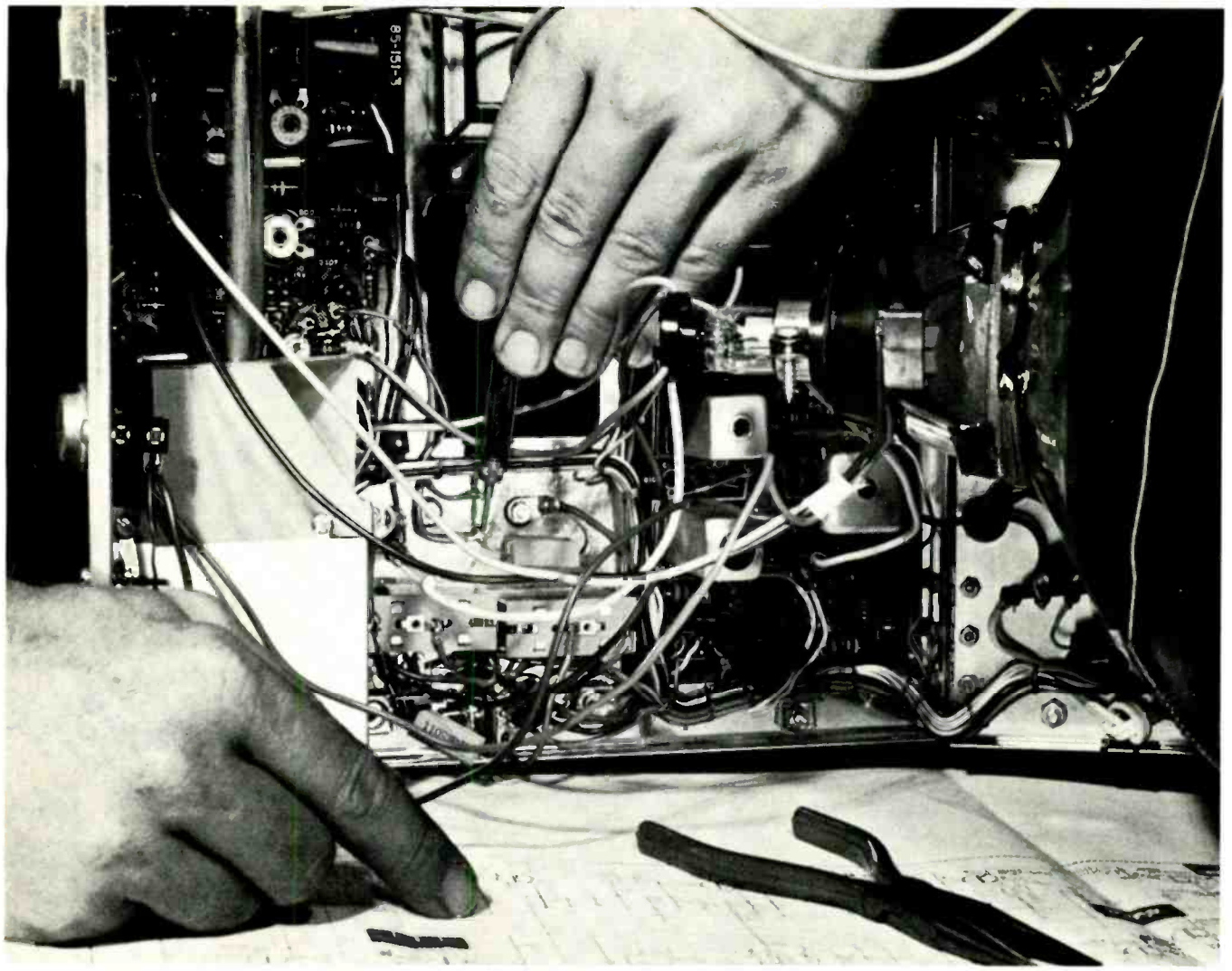

is to have the actual equipment in your hands.

Telephone License. *NTS assures you will pass this FCC exam within 6 months after successfully completing your course — or your tuition is refunded.* You receive 14 kits to build an amateur phone 6 meter VHF tranceiver plus NTS' exclusive 6 transistor solid-state radio and a fully transistorized volt-ohmmeter.

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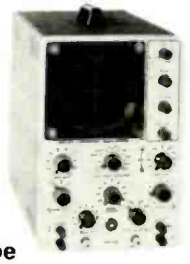

5" Oscilloscope

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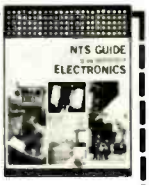

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The author is shown making use of his logical filing system to locate technical articles of immediate interest.

Filing Technical Articles

By HARDIN STRATMAN
Project Engineer, Gates Radio Co.

A logical system for filing technical articles can provide an instant source of information on state-of-the-art techniques.

READING and, above all, maintaining a well-organized file of good technical articles can be extremely useful as a future source of reference since such articles often incorporate the latest ideas of many competent scientists, engineers, and technicians. Large and expensive technical books are often published with a hint that up-to-date information on modern techniques and circuitry is included, but all too often, the author's particular insight and circuit "goodies" are omitted. On the other hand, a technical article usually retains the original thinking of the author. It is also a lot less expensive to acquire than a technical book.

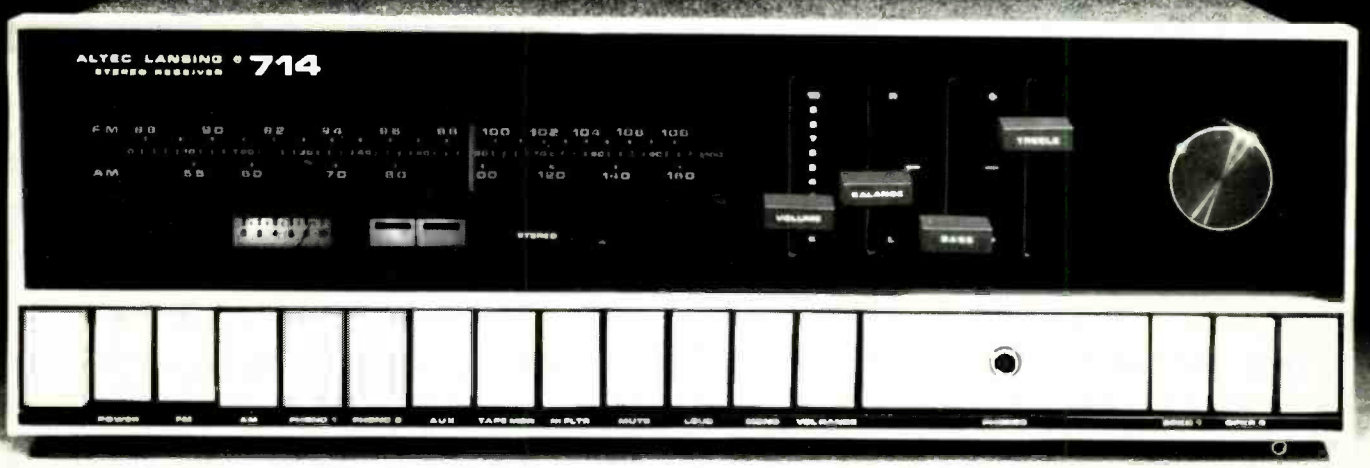
The value of an up-to-date file of technical articles becomes quite obvious to those involved in designing circuits or products when the answer to a pressing problem is to be found in a readily accessible article. Utilizing the fruits-of-labor of others who have shared their knowledge in a technical article, although somewhat ego-shattering, can save the designer many hours of wasted effort and considerable amounts of money.

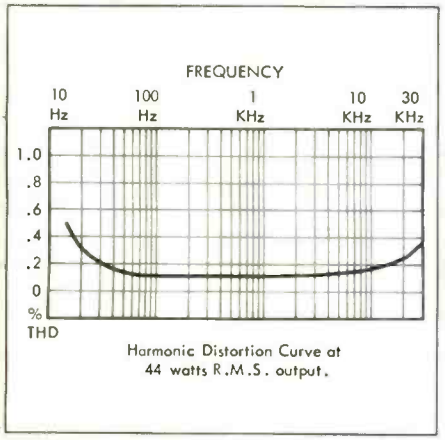
This penchant for saving pertinent and interesting articles started about 20 years ago; out of which my present system of filing evolved. The development of this logical filing system all started with saving magazines that contained articles of interest. When the pile of magazines became too high, and space became scarce, I was forced to tear out useful articles, discard the magazines, and graduate to amassing piles of articles. Finally, in an attempt to establish some semblance of order, these piles of articles were put in alphabetical order in folders and then the folders were placed in a cardboard box. However, since many articles seemed to fit more than one category, out of sheer frustration in not knowing where to file them, I temporarily stopped reading magazines. The end result was, in addition to the box of articles, piles of articles and piles of unread magazines.

Consequently, after many years of experimenting with filing systems, the one that was finally adopted involved arranging articles in folders, according to a special indexing scheme, which were then placed in a file cabinet. The basic idea of this indexing scheme was to choose major categories such as Amplifiers, Antennas, Audio, etc. and list them in alphabetical order and then to list under each of these categories, also in alphabetical order, the types that fall within this group. For instance, under a major category such as Amplifiers, we would list (in alphabetical order) audio, IC; audio, limiting; audio, p.a.; etc. In addition, to facilitate access to a subject of interest, a corresponding index was fastened to the front of each drawer, as shown in the photo, for easy reference.

This logically arranged technical file is a very useful asset since it saves space, looks better, and, most important, provides immediate access to any subject of special interest. ▲

Altec's new 714A receiver. It's built a little better.





Harmonic Distortion Curve at 44 watts R.M.S. output.

With 44/44 watts RMS power at all frequencies from 15 Hz to over 20 KHz (at less than 0.5% distortion). Most receivers meet their power specifications in the mid-band but fall way short at the critical low and high frequencies. The above curve shows the typical low distortion at all frequencies from the new 714A receiver at 44 watts RMS per channel. For comparison purposes, we also rate the 714A conservatively at 180 watts IHF music power at 4 ohms. This means that the 714A will handle everything from a full orchestration to a rock concert at any volume level with power to spare.

With 2 crystal filters and the newest IC's. Ordinary receivers are built with adjustable wire-wound filters that occasionally require periodic realignment. And unfortunately, they are not always able to separate two close stations. So we built the new 714A with crystal filters. In fact, 2 crystal filters that are individually precision aligned and guaranteed to stay that way. To give you better selectivity. And more precise tuning. The new 714A also features 3 FET's and a 4 gang tuning condenser for high sensitivity.

Built a little better.

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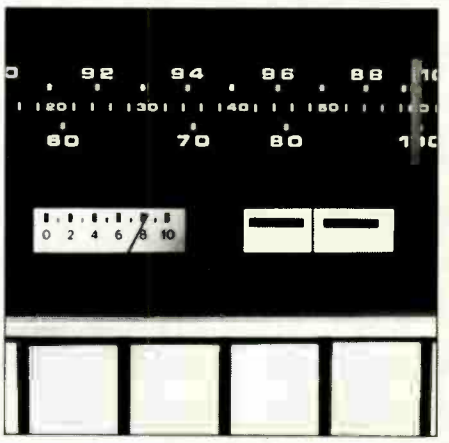

And with a lot of other features like these. Separate illuminated signal strength and center tuning meters on the front panel. A full 7 inch tuning scale and black-out dial. The newest slide controls for volume, balance, bass and treble. Positive-contact pushbuttons for all functions. Spring loaded speaker terminals for solid-contact connections.

Altec's new 714A AM/FM Stereo Receiver sells for $399.00. It's at your local Altec hi-fi dealer's. Along with all the other new Altec stereo components —including a new tuner pre-amp, new bi-amp speaker systems and all-new high-performance music centers.

For a complete catalog, write to: Altec Lansing, 1515 South Manchester Ave., Anaheim, California 92803.

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CIRCLE NO. 113 ON READER SERVICE PAGE

The Teldec Television Disc

(Continued from page 37)

However, on the economic front, the *Teldec* device may well be the winner. The cost of the player unit is the lowest by far of any of those mentioned, as is also the price of the records. It is simple to use—much like a regular phonograph.

The disc also has many of the features of the other devices, such as stop motion. It is also claimed that the records are extremely wear-resistant and over 1000 playings can be made before the signal-to-noise ratio drops below 40 dB. In addition, one advantage of the disc is that it can be made to start playing at any point in the whole recording and can be quickly moved to any other point—this is something which cannot be done easily with a tape or film system.

One characteristic of the *Teldec* system which it shares with EVR and SelectaVision is that you cannot make your own recordings—you can only play factory-produced records. For making your own recordings, the video tape recorder is the only way at present.

It should also be noted that as both the disc and the video tape recorder are waveform recorders, they are "standards conscious." That is to say discs or tapes recorded at one television standard (*e.g.*, the U.S. 525-line, 60 fields-per-second) cannot normally be played on equipment designed for another standard (say, the European 625-line, 50 fields-per-second). This may not be much of a problem for the home video-recording buff, but it could pose many problems in mass production and distribution of educational and popular entertainment recordings.

Home entertainment and classroom instruction are obvious applications for the video disc; other uses are likely to be in vocational and sales training, advertising and sales messages to both dealers and consumer. The disc may also find application in high-density storage of digital data for computer use, or storage of audio data alone for multichannel stereo records. ▲

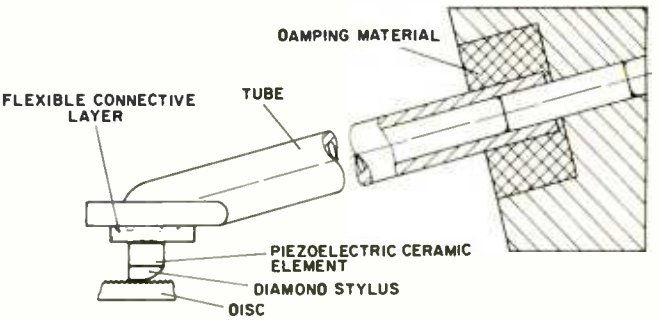
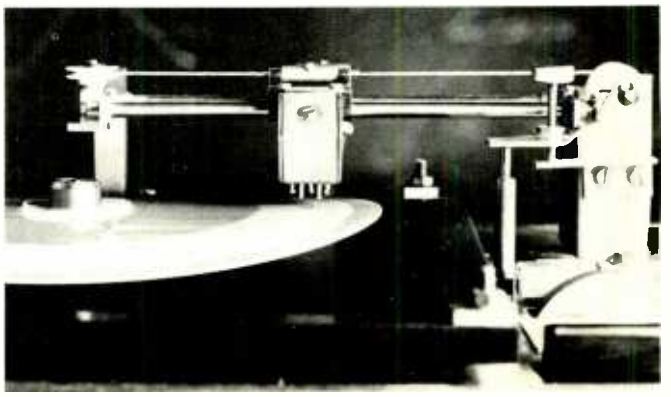


Fig. 3. The pickup head assembly. The transducer is connected to the pickup arm by means of an elastic coupling.

Closeup of the pickup and slider arrangement used. A cable moves the assembly slowly along the radius of the disc. If the drive is disconnected, the stylus and transducer follow several grooves in the video disc, thereby repeating a small portion of the program.



SONY® achieves true integration

In all too many transistor integrated amplifiers, the preamp stage does not quite live up to the performance of the amplifier section.

Not in Sony's new TA-1130. Thanks to an FET front end, this integrated package has a preamp stage that really does full justice to its output section.

Why FET's

For the same reason that we use them in our tuners and receivers, and in our studio professional condenser microphones; because FET's have a far wider dynamic range than ordinary transistor types.

And the preamplifier needs that range. Because it has to be sensitive enough to handle the lowest-output, moving-coil cartridges, yet still accept the highest output cartridges without overloading. (The power amp has it easier: you keep its input level fairly constant with your volume control.)

Power to Spare

But if the power amplifier doesn't need that range, it does need power. The output section of TA-1130 has it: 230 IHF watts (into 4 ohms), with continuous power rated at 65+65 watts into 8 ohms. (With all that power, we made sure that both transistor and speaker protection circuits were included.)

SONY® F.E.T. Amplifier

Nothing Stands Between You and the Sound

Both sections are powered by balanced positive *and* negative supply voltages (not just positive and ground), so there need be no coupling capacitors or interstage transformers between you and the sound.

Without them, the TA-1130 can extend its power band width down to 7 Hertz, and actually *exceed* its rated damping factor of 100 all the way down to 5 Hz.

An Abundance of Audiophile Conveniences

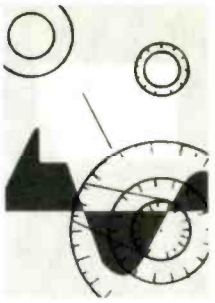
Of course, the TA-1130 has all the control facilities that you could ask for: low and high filters, tape monitor, a speaker selector, and even an Auxiliary input jack on the front panel. The selector switch is Sony's instant-access knob-and-lever system.

There's even provision to use the TA-1130's power amp and preamp sections separately, to add equalizers, electronic crossovers, or 4-channel adapters to your system.

In fact, you can even get the power output section separately, as the model TA-3130 basic amp. It makes a great match for our TA-2000 preamp, too.

Your Sony dealer has both models available, and at prices—$359.50 for the TA-1130; $239.50 for the TA-3130. Sony Corporation of America, 47-47 Van Dam Street, Long Island City, New York 11101.

CIRCLE NO. 115 ON READER SERVICE PAGE



TEST EQUIPMENT

Product Report

Triplett 4228-N Digital Panel Meter

For copy of manufacturer's brochure, circle No. 3 on Reader Service Page.

ONE unique feature of the new *Triplett* 4228-N digital panel meter is its half-digit display which effectively doubles the accuracy and resolution of the instrument. The meter is rated at an accuracy of ±0.25% of reading ±½ digit. The company describes the unit as a "2¾-digit" instrument. This means that it has two complete display decades (from 0 to 9), a neon lamp that either does or does not illuminate a left-hand "1" for hundreds display, plus two other neon lamps that illuminate either the small ".5" or ".0" digits at the extreme right. As the counters operate in the meter, the display advances by half counts rather than full-digit counts, effectively doubling accuracy and resolution.

If a voltage or current that is beyond its range is applied to the meter, then the clock runs constantly causing all numbers to appear simultaneously in a clear, sharp display. If a negative-polarity voltage or current is applied, then a soft, blurred display is produced.

This highly accurate, small digital panel meter may be front- or rear-panel mounted, or can be used on a bench top. The meter measures about 2.3-in high by 4.1-in wide by 4.8-in deep. It operates from the 117-volt a.c. power line and its solid-state circuits draw about 2 watts from the line.

A number of different d.c. voltage and current ranges are available. These are 0 to 199.5 mV, 1.99 V, 19.95 V, 199.5 V, 1000 V, and 0 to 199.5 μA, 1.995 mA, 19.95 mA, 199.5 mA, 1.995 A. The company builds to order the specific range desired by the customer by using the same basic digital meter circuits and adding suitable multipliers or shunts.

The Model 4228-N is priced at $140 in single-unit quantities. A Model 4225-N, with indicating capabilities to 99.5 and accuracy of ±0.50% of reading ±½ digit, is available at $125. Also a 2-digit meter, with indicating capabilities to 99 and accuracy of ±1% of reading ±1 digit, is priced at $110. ▲

Sencore SM158 Sweep/Marker Generator

For copy of manufacturer's brochure, circle No. 4 on Reader Service Page.

IN an effort to cut TV alignment time, *Sencore* has introduced a new, simplified sweep/marker generator, Model SM158, which has been named the "Speed Aligner." This generator differs from the company's previous Model SM152 in a number of important respects. First, it is about $125 cheaper; the SM158 sells for $275 compared to the close to $400 price tag on the earlier model (covered in our August, 1969 "Test Equipment Product Report"). The newer generator does not cover any of the u.h.f. TV channels but it does cover four v.h.f. channels. It is also smaller in size, simpler to use, and has much greater marker amplitude.

There are only three leads that must be interconnected from the generator to the TV set and the scope on which

the sweep response curve is viewed. One of these, the r.f. output, has a built-in matching pad. The second, the detector input, has a built-in detector circuit. The third, which is the detected output combined with the post-injection markers, goes to the vertical input terminals of the scope. A fourth lead, to the horizontal input terminals of the scope, is used if you want to flop your markers by 90 degrees.

All the markers are crystal-controlled and are operated by means of 8 push-buttons on the front panel. These markers show up simultaneously on the i.f., r.f., or chroma response curves of the TV receiver. The markers are about four times larger than those of the company's previous sweep generator, permitting much larger amplitudes to be displayed. Because of the use of post-injection, no matter how large the markers are made, the shape of the response curve is not affected.

There is plenty of sweep width available; a full 15-MHz sweep signal is produced. Also a zero-reference base line is generated.

Incidentally, the company is holding alignment clinics to teach TV technicians sweep-alignment, using this new sweep/marker generator. ▲

B&K Model 466 CRT Tester/Rejuvenator

For copy of manufacturer's brochure, circle No. 5 on Reader Service Page.

THE new *B&K* Model 466 tests and rejuvenates all black-and-white and color picture tubes, including *Sony's* Trinitron and *GE's* 11-in tube used in their portable sets. The unit tests the tubes for opens, shorts, or leakage between elements; rejuvenates guns; repairs shorted or leaky tubes in many cases—all without removing the CRT from the receiver.

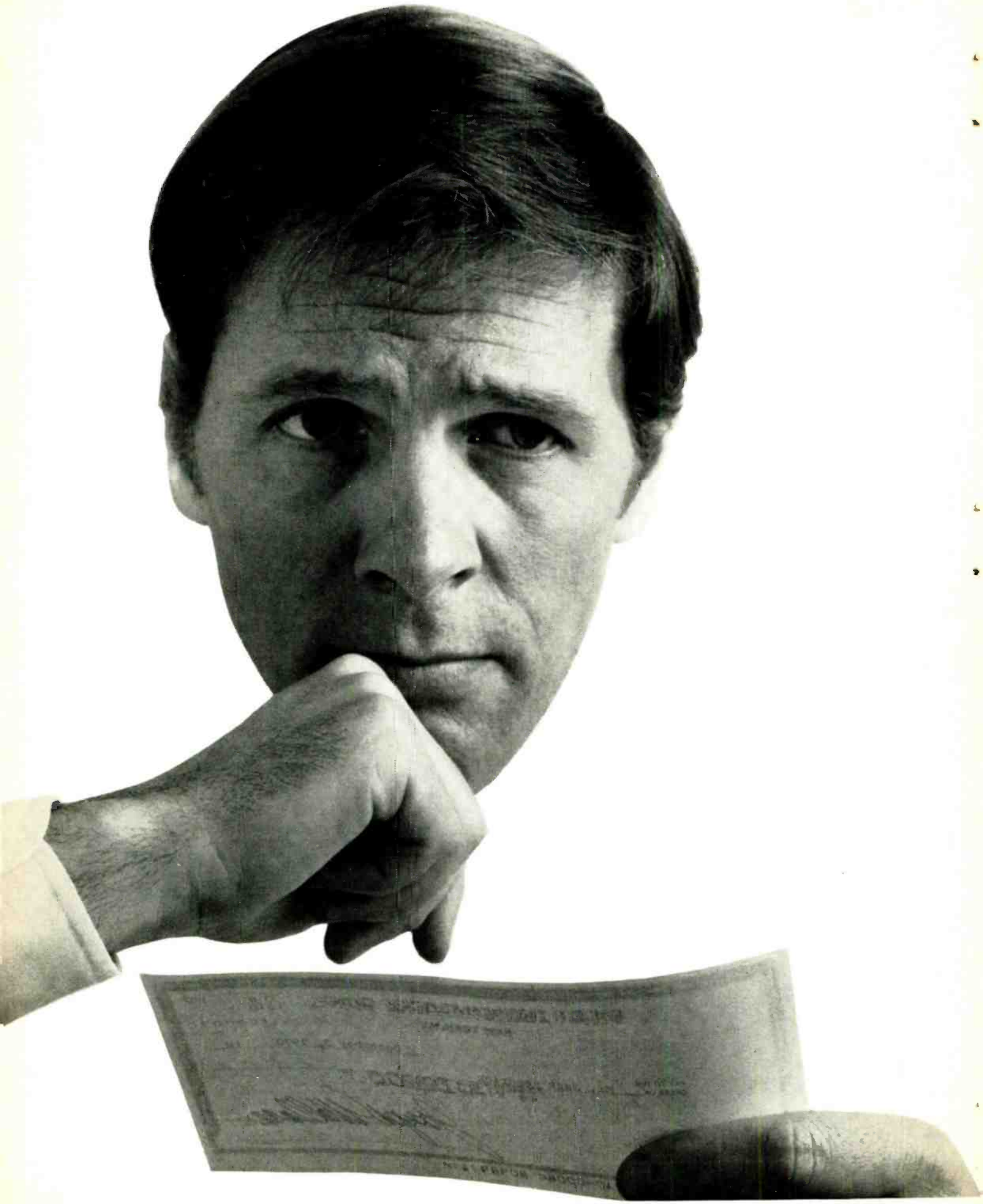
The tester checks the amount of emission from the cathode(s) of the picture tube, measuring each gun in a color tube separately. It is possible to obtain the relative emission balance between the guns and check on the tracking between guns.

In setting up the tester, the heater voltage and voltages applied to grids #1 and #2 are variable and are monitored on the large front-panel meter. Hence, the tester should not become obsolete with the introduction of new tubes with different operating voltages.

There are three steps provided for the rejuvenation function. The first two of these are timed automatically to prevent damage to a tube. In the third step, the rejuvenating voltage is applied for as long as a push-button is held down. This position is used in an attempt to restore the emission of an aging and otherwise worthless CRT. By monitoring the relative cathode emission improvement before and after rejuvenation, the technician can see just how much good the rejuvenation has done.

The setup of the instrument as well as the arrangement of the instruction manual have been done very logically so that it would be difficult to damage any picture tube being tested.

The Model 466 is built into a lightweight carrying case, measuring 13¼" × 9½" × 5¼". Price $129.95. ▲



Your paycheck says a lot about you

It tells you more than how much you make. It tells you how far you've come. And if your paycheck looks very much the same as it did last year, or the year before, it simply means that *you* look very much the same as *you* did last year and the year before.

But times change, and you should be changing with them. Old dull jobs are disappearing. New exciting ones are being created. There are challenging new fields that need electronics technicians ...new careers such as computers, automation, television, space electronics where the work is interesting and the earnings are greater.

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Telecommunications

(Continued from page 40)

Even with those escape clauses, six developing nations entered a reservation against this Recommendation. One reason they gave was that it was too difficult to calculate the prohibited antenna azimuths and elevations. Actually they had a very good argument because it is not just a problem of solid geometry; the effects of atmospheric refraction change both the azimuth and elevation angles to the orbit. To help ease this problem, the U.S. then prepared a report that included a simple graphical method that could be used to determine the prohibited antenna pointing angles. This Report was then adopted by the following Plenary, recently held in New Delhi.

In addition, there were other actions implemented at this Plenary that will have an effect on our use of space and will certainly affect people in the electronics field. There will be more—and different—systems to design, build, install, and operate.

Study Group 4, for example, adopted Reports on the use of frequencies above 10 GHz for communications satellites. As the presently allocated frequency bands fill up, we will be driven to higher ones, but the characteristics of these bands are different—rain attenuation is more of a problem. On the other hand, these satellites would probably use spot beams and they could be spaced closer together in orbit. Coordination problems between radio-relay stations and satellite earth stations will be easier.

Other Reports discussed modulation methods, how to calculate interference, and a "reference" pattern for satellite earth-station antennas. We have to study these questions so that we will know how to design systems in these bands when the time comes. Fourteen other Reports laid the groundwork for aeronautical and maritime use of satellites for communications and navigation. These papers discussed the choice of frequencies, performance objectives, the influence of intermodulation on transponder design, modulation techniques, and the joint use of satellites by different services. These are all points that must be agreed upon internationally before anybody can push the button that blasts a satellite into orbit.

Study Group 9 sent sixty-six documents to the Plenary. These dealt with the preferred characteristics for radio-relay and troposcatter systems, with digital modulation methods for these systems, and the use of 12 and 15 GHz for radio-relay. Other Reports described what order-wire circuits should be provided, new pre-emphasis curves for TV, and preferred characteristics for the new 2700-channel radio-relay systems.

Establishing a Position

The way the United States arrives at a position for a conference like the WARC is different from the CCIR or CCITT mechanism. Long before the meeting, the FCC, the Office of Telecommunications Policy, and other government agencies, acting through the Interdepartment Radio Advisory Committee (I.R.A.C.), will draw up a proposal for revised frequency allocations and rules. This will be issued to the public for comment in an FCC "Notice of Inquiry." Companies, industrial organizations, perhaps the ARRL, and other groups representing specialized users of the spectrum can then file their comments with the FCC. These comments, and those of government agencies, are taken into account in subsequent revisions of these proposed allocations. To date, there have been 7 such Notices of Inquiry for the 1971 WARC as a result of the continuing interchange of comments and suggestions by government agencies, the public, and private organizations.

Finally, the agreed position is taken to the conference by the U.S. delegation. There, for six weeks or more, they will discuss each of the proposed allocations and rules. As with the CCIR and CCITT, almost all questions are resolved unanimously. But here, too, an Administration may enter a reservation. Most of these have technical reasons: one country may have been using a band for a certain service and have a lot invested in equipment for that band. Their reservation might say that they intend to continue using that band for the original service even though other countries will use it for a new service. In the case of Cuba, their reservation on the allocation of 608-614 MHz for radio astronomy was purely political: they just weren't going to agree with the U.S. in 1963.

The results of a Conference are also published by the ITU Secretariat. The latest edition is a volume entitled "Radio Regulations, edition of 1968."

Reaching international agreement in any field is always difficult and time-consuming. The over-all record of successful agreements on telecommunications problems during the past 100 years should convince us that nations can live together and work out their differences. It should also be a cause for satisfaction to us in electronics that our particular field has one of the best records of international cooperation and agreement. ▲

**Any opinions expressed in this article represent the author's personal views and do not necessarily reflect the views of the United States Government.*

NEW PRODUCTS & LITERATURE

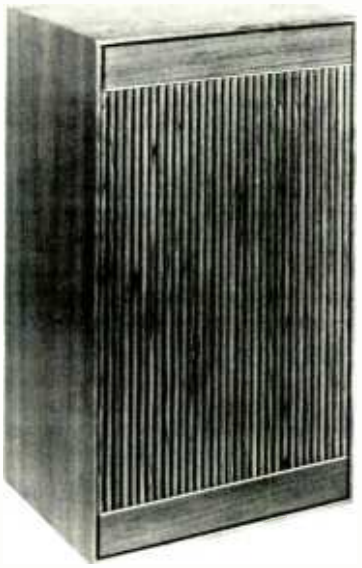
For additional information on items identified by a code number, simply fill in coupon on Reader Service Page. In those cases where code numbers are not given, may we suggest you write direct to the manufacturer on business letterhead.

COMPONENTS • TOOLS • TEST EQUIPMENT • HI-FI • AUDIO • CB • COMMUNICATIONS

COMPACT SPEAKER SYSTEMS

Two compact speaker systems, one a two-way and the other a three-way, have just been introduced as the "Zodiac II" and "Zodiac III" respectively.

The two-way speaker system has a response from 40-18,000 Hz and can be used with amplifiers having a minimum power output of 15 watts/channel. Crossover is at 2000 Hz and the wide dispersion angle of the tweeter allows full stereo effect under all conditions, according to the company. The cabinet measures 18" × 11½" × 8" and the system has a nominal impedance of 5 ohms.



The three-way model covers the range from 38-20,000 Hz and is designed to be used with amplifiers having a minimum output of 20 watts per channel. Crossovers are at 2000 and 8000 Hz. The cabinet measures 20" × 12" × 8½". Nominal impedance is 5 ohms. Hartley

Circle No. 6 on Reader Service Page

D.C. POWER SUPPLIES

A line of 450 professionally engineered d.c. power supply kits for commercial, industrial, laboratory, and university use is now available in capacitor or choke input, regulated and unregulated versions.

Voltage ranges are from 5 volts through 120 volts with current ratings of 0.25 to 50 amperes. Regulated supplies use integrated-circuit techniques and are available to 0.01% regulation.

The kits are designed to be assembled in minimum time with basic tools. No complex wiring is involved. The plug-in PC boards used in the regulated supplies are completely wired, tested, and sealed. Techni-Kit

Circle No. 7 on Reader Service Page

RADIO/DIRECTION FINDER

The CR-44A "Ranger" is an all solid-state radio with navigational direction finder that tunes marine and aircraft beacons and covers the 2 to 5.2-MHz short-wave band.

The radio tunes over the 200-400 kHz range where d.f. beacon stations transmit. It has superior image rejection eliminating signals from the broadcast band so d.f. signals are free from interference, according to the company. The finder is equipped with an improved a.g.c. and special 20-dB transistor amplifier used in the meter circuit for null indication.

The newly designed circuit provides for extended battery life (400 hours), precise signal-locking reliability, and over 500 watts of audio output power.

Besides the short-wave services, the new unit provides AM reception of the standard broadcast band, full fidelity entertainment on the FM band, sensitive reception of FAA and Canadian weather-navigation stations, and marine and aviation radio beacons on the 185-400 kHz long-wave range. Hallicrafters

Circle No. 8 on Reader Service Page

REGULATED POWER SUPPLIES

A new series of continuously variable regulated power supplies is now on the market, offering output voltages from 1 to 30 volts with continuous current ratings at 2 amperes.

The supplies can be ordered in a package consisting of one, two, or three basic units. The output of each basic unit can be combined in any desired manner—series or parallel—to meet a wide variety of requirements, including voltages to 90 volts and currents to 6 amperes.

A comparison chart on the PS-60 series is available on request. Blulyne Electronics

Circle No. 9 on Reader Service Page

SEMICONDUCTOR REPLACEMENTS

The ECG line of semiconductors includes a repair kit which replaces 95 percent of the most popular solid-state components found in home-entertainment products.

Designated ECG303, the repair kit consists of 24 commonly used semiconductor devices which are replacements for over 20,000 equivalent types. The kit includes a replacement guide which provides cross-reference and technical information on over 35,000 JEDEC types and manufacturers' parts numbers, foreign and domestic.

The kit is attractively packaged and will fit into the technician's tube caddy. Sylvania

Circle No. 10 on Reader Service Page

MARINE RADIOTELEPHONE

The "Bimini 500" pretuned marine radiotelephone has four channels plus a tunable broadcast band. This 50-watt unit is designed to be installed by simply connecting it to the boat's battery and putting up the antenna.

With a case constructed of high-impact Cycolac, the unit weighs only 8¾ pounds and measures 8½" wide × 3¾" high × 9½" deep. It comes complete with a 10½-foot fiber glass antenna, mounting hardware, press-to-talk handset, and three pairs of crystals. Pearce-Simpson

Circle No. 11 on Reader Service Page

VARIABLE-SPEED DRILLS

Four high-performance, double-insulated reversible and variable-speed power drills with 2.8 and 2.6 ampere, ½-horsepower motors have been added to the company "Pro" line of power tools.

Designed for electrical and electronic applications, the drills feature "unitized construction" and rugged housings. These balanced drills have a man-sized grip and center drop-handle design.

With the unitized construction the power unit is mounted in a die-cast metal frame or superstructure. To this is also assembled the gear train and associated components, thereby insuring optimum structural stability to all functional parts. With this internal construction, perfect alignment between drill chuck and motor is assured, according to the company.

Details on the four drills in this new line will be supplied on request. Wen Products

Circle No. 12 on Reader Service Page

SSB/C.W. TRANSCEIVER

The HW-101 5-band SSB/c.w. transceiver incorporates many of the features of the predecessor Model HW-100 including 80-10 meter capability, 180-watt p.e.p. input, built-in vox, and crystal calibrator. New features include an improved 36:1 ball-bearing dial drive assembly for smoother, more accurate tuning; improved receiver circuitry which increases the sensitivity to 0.35 μV for 10 dB S±N/N; and provision for front-panel selection of built-in 2.8-kHz SSB crystal filter or the optional 400-Hz c.w. crystal filter.

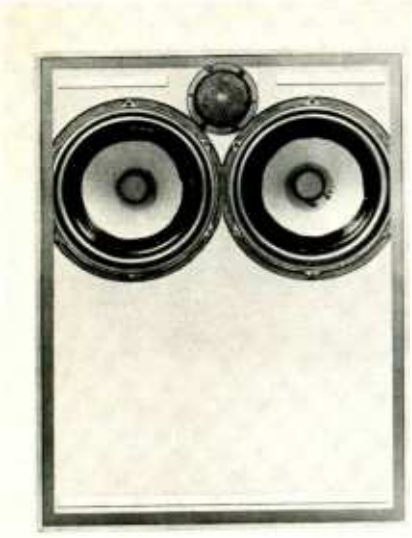
Complete details on this new kit are available for the asking. Heath

Circle No. 13 on Reader Service Page

SPEAKER SYSTEM

The new A-50 aperiodic loudspeaker features dual-spectrum damping which combines effective damping of low frequencies with extended low-end performance. This is achieved by using two high-compliance woofers and two air-tight cabinet compartments connected through an acoustical resistance.

According to the company, the aperiodic nature of the baffling arrangement provides superior transient performance at low frequencies. At high frequencies, smooth extended response is attained with a hemispherical soft-dome tweeter, crossed over at 1 kHz. Phase distortion is minimized by a non-inductive crossover network which makes effective use of the transduc-



er characteristics to augment the transition from woofers to tweeter.

Housed in a free-standing, slim-line cabinet measuring 28" high × 21½" wide × 10" deep, the unit comes with a detachable linen grille cloth. Dynaco

Circle No. 14 on Reader Service Page

COMPACT STEREO SYSTEM

A compact AM/stereo-FM/phono system has recently been introduced as the 2516. Available with the choice of one of the company's three air-suspension speaker systems, the 2516 features solid-state circuitry, including FET front end, IC i.f. amplifier, and direct-coupled all-silicon output circuits.

The automatic turntable is a Garrard 3-speed unit with a Pickering V-15 magnetic cartridge.

The system offers automatic stereo switching, stereo indicator light, signal-strength meter, and a complete complement of operating controls. Also included are provisions for plugging in a tape recorder or tape cartridge player, stereo headphones, or extra speakers.

Complete details on this new system are available on request. H.H. Scott

Circle No. 15 on Reader Service Page

FREQUENCY COUNTER KIT

The new IB-101 frequency counter kit uses computer-type integrated circuits to provide accurate counting from 1 Hz to over 15 MHz and eliminate divider chain adjustment. An overrange indicator and Hz/kHz switch give the unit's five cold-cathode display tubes the same capability as a much more expensive 8-digit counter, according to the company. Readings to the nearest kHz are made with the range switch in the kHz position. Pushing the range switch to the Hz position allows reading figures down to the last Hz.

An exclusive input circuit uses a dual-gate, diode-protected MOSFET to provide proper triggering from less than 100 mV to more than 200 volts without input level adjustment. Input impedance is 1 megohm shunted by less than 20 pF to minimize circuit loading and error.

The company estimates that it takes five hours to assemble the counter on one double-sided, plated-through circuit board. Heath

Circle No. 16 on Reader Service Page

COLOR-ORGAN KITS

Two new color organs in kit form have been introduced as the M-25 and M-27.

Both units can be used with AM-FM radios, tape decks, stereo systems, or musical instruments. The M-25 is 24" high × 12" square and comes with two different prism plates for a "3D" effect. It provides four square feet of viewing surface. The M-27 with the same dimensions has four different prism plates so that by placing the unit on its side ten square feet of viewing surface are available. Electronic Light

Circle No. 17 on Reader Service Page

STEREO AMPLIFIER

A 95-watt, solid-state stereo amplifier which features a frequency response of 20-40,000 Hz (±1.5 dB) and a power bandwidth from 18-30,000 Hz (IHF), is now available as the Model KA-4002.

The amplifier provides terminals for two pairs of stereo speakers, plus center channel; two phonographs; two auxiliary lines; and a tape deck. A front-panel speaker selector switch controls the main speakers alone, remote speakers alone, or main and remote speakers together, and stereo headphones. Step-type tone controls adjust treble and bass while push-button controls are used to regulate loudness, high and low filter, stereo mode, and tape monitor. Kenwood

Circle No. 18 on Reader Service Page

CASSETTE DEMAGNETIZER

The Model SA-75 head demagnetizer for cassette players/recorders reduces wear and extends tape head life, according to the manufacturer. It removes magnetic buildup from the tape head and prevents sound distortion. The unit comes complete with a plug-in a.c. cord. Duotone

Circle No. 19 on Reader Service Page

CYLINDRICAL SPEAKERS

Three styles of cylindrical speakers molded in plastic to resemble wood are now available in traditional, Spanish, and Oriental designs. The systems are finished in walnut, green, or natural to match home decorating schemes.

The speaker measures 11½" × 16½" and is designed to be used either on a bookshelf or as a free-standing floor unit. Each enclosure houses a 6" high-compliance woofer and a 3½" tweeter. The enclosure is damped by fiber glass pads to reduce cavity resonance. Power per speaker system is 20 watts. A phono jack and two coded screw terminals allow easy hookup to other equipment. Becker Electronics

Circle No. 20 on Reader Service Page

4-CHANNEL TAPE DECKS

Three 4-channel tape decks, all of which are three-motor, solenoid-operated auto-reverse types, have recently been introduced as the Models TCA-40, TCA-41, and TCA-42.

The Model TCA-40 has a ¼-track, 2-channel stereo playback and a 4-channel stereo playback (in-line) capability. It also includes ¼-track, 2-channel erase and record heads which may be used for future step-up capabilities of the equipment. It features automatic reverse for uninterrupted playback of two-channel tapes. It has built-in solid-state preamps.

The Model TCA-41 incorporates 2-channel and 4-channel playback, 2-channel record, and may be modified for 4-channel record capability.

The top-of-the-line TCA-42 incorporates 2- and 4-channel playback, 2- and 4-channel record, automatic reverse for 2-channel operation, and a total of eight separate solid-state playback and record amplifiers and off-the-tape monitor selectors. Teac

Circle No. 21 on Reader Service Page

STEREO RECEIVERS

Three new receivers have been introduced as the Mark 10, Mark 12, and Mark 20, with power ranges of 100, 150, and 300 watts, respectively.

All three receivers include solid-state circuitry throughout and use FET's, IC's, and silicon transistors for minimum noise, maximum selectivity, and high reliability, according to the manufacturer. Patented power-transistor protection circuits plus built-in speaker protection circuits prevent any possible damage from shorts or overloads.

Complete specifications on this new series of receivers will be supplied on request. Concord

Circle No. 22 on Reader Service Page

RECORD PREAMPLIFIER

A compact, professional record/playback preamplifier, specifically designed for magnetic tape recording and playback with standard NAB calibration, has been introduced as the Model RP-84.

This solid-state unit can be used with either two- or three-head tape transports and includes an A-B tape-monitor switch. An equalization selector switch and a slow/fast speed switch match the unit to any tape transport operating from 1⅞ to 15 in/s. Bias adjustment of the RP-84 provides optimum record level and an overall frequency response from 30-18,000 Hz ±3 dB at 7½ in/s.

The RP-84 can be used with quarter-, half-, and full-track head configurations and provides mixing of microphone and line inputs. It has a high-impedance phone jack, vu meter, record light, and record interlock. Telex

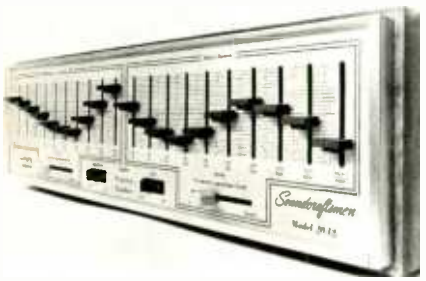
Circle No. 23 on Reader Service Page

AUDIO-FREQUENCY EQUALIZER

The 20-12 equalizer is designed to improve home stereo reproduction by permitting frequencies to be balanced precisely.

The equalizer incorporates both active and passive circuits to provide simplified adjustment of individual octaves. Perfectly flat response is assured when all controls are at zero setting, according to the company. Response curves are designed for optimum frequency control by octaves, with a broad skirt at low settings and increasing sharpness as the control is cut or boosted to higher settings. In this way, a ±2 dB curve can be established in all but the sharpest and most critical peak and valley room conditions.

A special test record that provides alternate pink noise tones and 1000-Hz reference tone is included with each model. Step-by-step instruc-



tions on the record guide the user in making room equalization.

A data sheet providing full details on the 20-12 is available. Soundcraftsmen

Circle No. 24 on Reader Service Page

VECTORSCOPE/COLOR GENERATOR

A new TV service instrument, the IO-101 vectorscope/color generator, is now on the market in kit form.

The instrument combines conventional solid-

state devices with computer-type integrated circuitry to provide visual readout of the important characteristics of the chroma signal. It also produces the standard 9 × 9 display of color bars, shading bars, dots, crosshatch, vertical lines, and horizontal lines in addition to a 3 × 3 display of all these patterns and a clear raster for purity adjustments. Heath

Circle No. 25 on Reader Service Page

MANUFACTURERS' LITERATURE

SEMICONDUCTOR GUIDE

A new cross-reference and replacement guide (HEP HMA-07) is now available through the company's nationwide distributor network. This guide cross-references more than 25,000 devices to HEP replacements including 1N, 2N, 3N, JEDEC, Japanese, Dutch, and other foreign numbers in addition to thousands of manufacturers' regular and special "house" numbers.

The publication gives min/max ratings and electrical characteristics for 285 HEP devices, as well as the cross-reference information. The HEP devices are listed by type numbers with a packaging index, device dimension drawings, and selection guide information. Motorola

Circle No. 26 on Reader Service Page

COLOR-TV CONTROLS

A 32-page, vest-pocket-size cross-reference listing of color-TV controls for convergence, audio, color, a.g.c. delay, focus, brightness, sensitivity, horizontal frequency, horizontal centering, vertical linearity, and vertical centering is now available.

The booklet lists manufacturers' original part numbers cross-referenced to the firm's replacement parts. The 105 part numbers are presented in numerical order with specifications and illustrations of each part.

Copies of No. X67 will be forwarded on request. Workman

Circle No. 27 on Reader Service Page

TOOL BULLETIN

Bulletin N670 introduces two new reversible ratcheting handles for use with more than sixty of the company's individually available Series "99" nutdriver, screwdriver, and special-purpose blades.

The data sheet carries a photograph showing how the ratchet reversing shift, easily operated by a flick of the thumb, is recessed in the handles to prevent accidental tripping while driving. Xcelite

Circle No. 28 on Reader Service Page

TECHNICAL TRANSFERS

Datek Corporation, 85 Highland Avenue, Passaic, N.J. 07055 has released an all-new catalogue that lists its special-purpose and technical dry transfers.

Included for the first time are 128 new "Jet-Draft" printed-circuit and component patterns as well as a series of direct etch resist kits. These sets all use a tough new plastic ink film that is different from other dry transfer materials.

A letterhead request will bring a copy of the catalogue and a sample of the new material.

ASTM PUBLICATIONS

The American Society for Testing and Materials (ASTM) has issued a list of its publications in a 34-page bulletin which has just been revised and updated. More than 575 ASTM publications dealing with the knowledge of materials, materials evaluation, and the standardization of methods of test and specifications for materials are listed.

A request on your company letterhead to ASTM, 1916 Race St., Philadelphia, Pa. 19103 will bring a copy.

ELECTRIC SWITCHES

Robertshaw Controls Company has just issued a new 40-page catalogue covering its line of precision electric switches designed for replacement applications.

The catalogue covers 140 models of switches and gives a complete cross-reference to other manufacturers' products. Electrical and mechanical specifications are provided on each model, along with a picture of the switch.

Your letterhead request should be addressed to the Uni-Line Division of the firm, Huntington Beach, Calif. 92647. Ask for publication 2-016.

MATV SYSTEM GUIDE

A 56-page, full-line general distributor catalogue that includes a guide to MATV systems is now available from Jerrold Electronic Corporation.

Covering several TV distribution product lines, the catalogue includes nearly 300 of the company's products, some of which are recent developments. Included are product photos, specification tables, diagrams, and drawings plus a 10-page section devoted to application and installation of the products described in the catalogue sections.

Categories include system and home antennas, amplifiers, preamplifiers, and distribution components such as networks, traps, filters, converters, modulators, demodulators, splitters, tap-offs, outlets, matching transformers, connectors, adapters, cameras, and accessories.

Priced at $1.00, the new catalogue is available either at company distributors or direct from the Distributor Sales Division, 401 Walnut Street, Philadelphia, Pa. 19105.

POWER-SUPPLY KITS

An extensive catalogue covering 450 professional d.c. power-supply kits, both regulated and unregulated, for use by engineers and technicians is now available for distribution.

Each kit includes a punched chassis, all components, mounting hardware, schematic diagram, and instructions. The various options are presented in tabular form to make it easy to order the right kit for a specific job. Universal Electronics

Circle No. 29 on Reader Service Page

COMPONENTS CATALOGUE

A comprehensive catalogue which lists and describes a wide range of products for labs, industry, and experimental applications is now available as No. 711.

Listings include everything from camera lenses to an He-Ne gas laser and laser accessories. An extensive line of service chemicals and accessories is also listed. Edmund Scientific

Circle No. 30 on Reader Service Page

FM 2-WAY RADIO DATA

Two four-page, two-color brochures featuring the "Porta-Command" Models PC-210 and PC-230 FM two-way radios are now available for distribution.

Each brochure pictures and describes the units, provides complete specifications, suggests applications, and points out special features of the products. Hallicrafters

Circle No. 31 on Reader Service Page

TEST-EQUIPMENT CATALOGUE

A new all-line test equipment catalogue (No. 57-T) featuring digital v.o.m.'s, multi-purpose v.o.m.'s, FET types, laboratory accuracy v.o.m.'s, and v.o.m.'s with special features is off the press and ready for distribution.

Each instrument is pictured, described, and special features pointed out. Accessories for portable instruments are covered as are listings of company sales representatives, sales and service modification centers, and warranty repair depots. A tabular listing of the models permits quick and easy comparison of the various v.o.m.'s in the line. Triplett

Circle No. 32 on Reader Service Page

VARACTOR DATA SHEETS

Application notes and data sheets are now available on varactors for amateur radio service, microwave applications, and units specifically designed for use in "rubberized" crystal oscillator circuits.

Each data sheet provides basic application information, rating and characteristic data, and dimensional diagrams. Eastron Corp.

Circle No. 33 on Reader Service Page

STANDARD PANEL METERS

Triplett Corporation, Bluffton, Ohio 45817 has issued a 20-page catalogue covering its line of standard panel meters.

The contents are indexed on the front cover to facilitate easy selection. The catalogue covers meter characteristics; panel meters in $1\frac{1}{2}$", $2\frac{1}{2}$", $3\frac{1}{2}$", $4\frac{1}{2}$", $5\frac{1}{2}$", $6\frac{1}{2}$", $7\frac{1}{2}$", and $8\frac{1}{2}$" sizes; null meters; edgewise panel meters; ruggedized panel meters; wattmeters; vu and dB meters; panel-meter accessories; portable instruments; pyrometers; suspension meters; special meters; and information on sales and servicing facilities.

When making your letterhead request for this catalogue, specify No. D-70.

EIA STANDARDS

The EIA Engineering Department, 2001 Eye St., N.W., Washington, D.C. 20006 has released four new recommended standards which can be ordered from the Association.

RS-296-B covers reel packaging of components with axial leads and is a revision of RS-296-A ($1.00); RS-376 covers fixed film dielectric capacitors in metallic and non-metallic cases for d.c. applications ($4.80); RS-378 covers the measurement of spurious radiation from FM and TV broadcast receivers in the frequency range of 100 to 1000 MHz, using the EIA laurel broad-band antenna ($2.60); and RS-377 covers metallized dielectric capacitors in metallic and non-metallic cases for direct current applications ($4.20).

Orders should specify standard number and payment must accompany all orders.

WIRE, CABLE & TUBING

A fiftieth anniversary catalogue of wire, cable, and tubing products has just been published by Alpha Wire. The colorful 72-page illustrated publication describes more than 7000 products manufactured and marketed by the firm.

Catalogue W-7 includes descriptions and specifications on products ranging from hookup wire and multi-conductor cable to coax and zipper tubing.

To obtain a copy, write on your business letterhead to the Marketing Services Department of the company at 711 Lidgerwood Ave., Elizabeth, N.J. 07207.

RECTIFIERS & DIODES

Unitrode Corporation has published a new 34-page design guide and short-form catalogue describing its line of high-reliability rectifiers, zener diodes, microwave diodes, high-voltage "Doorbell" rectifier modules, "Magnum" high-current bridges, bridges and stacks, thyristors, transistors, programmable unijunction transistors, solid-state a.c. switches, and gate turn-off SCR's, A complete listing of JAN and JAN TX rectifiers, zeners, and SCR's is also included.

Letterhead requests should be addressed to the Inquiry Processing Service 7E of the corporation at 63 Atlantic Ave., Boston, Mass. 02110.

INDUCTORS & FILTERS

Cambridge Thermionic Corporation has just issued a new brochure covering solid-state inductors and LC filters.

Technical data provides specifications, application information, limitations, external wiring layouts, and mechanical specs on each of the items covered. Included is information on a solid-state inductor, a low- and high-pass block assembly, bandpass and rejection, tunable bandpass, variable encapsulated coils, toroids, and balun models.

Letterhead requests should be addressed to W.G. Nowlin, General Marketing Manager of the company at 445 Concord Ave., Cambridge, Mass. 02138.

HALL-EFFECT INSTRUMENTS

F.W. Bell, Inc., 4949 Freeway Drive East, Columbus, Ohio 43229 has announced the availability of a six-page short-form catalogue covering gaussmeters, magnet processing systems, non-destructive testing equipment, Hall multipliers, wattmeter transducers, and a wide range of types and sizes of Hall Pak generators. ▲

Answers to C.E.T. Test, Section #12

Published in Last Month's Issue

1. (A) 3; (B) 1; (C) 2; (D) 4
2. (d)
3. (a)
4. (c)
5. (a)
6. (c)
7. (b)
8. (d)
9. (a)
10. (d)

Answers to Audio Amplifiers Quiz

(appearing on page 41)

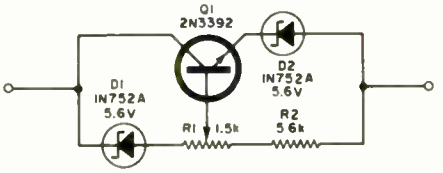
1. b	11. c
2. c	12. a
3. c	13. c
4. c	14. c
5. c	15. b
6. c	16. d
7. a	17. b
8. d	18. d
9. b	19. c
10. b	20. c

Variable Replacement For Zener Diode

By DONALD H. ROGERS
Sr. Adv. Development Engineer
Jerrold Electronics Corp.

The circuit designer often needs a precise or special value of zener voltage for reference or regulation. Suitable zener diodes can be procured, but rarely from stock. A substitute which can be put together from available components is attractive, especially if it can be adjusted at the last minute.

In the circuit shown (which is connected in place of the zener), the input voltage to transistor Q1 is the difference between the applied voltage across the two terminals and the sum of the drops across D1 and D2. When this difference exceeds the semiconductor drop in the base-emitter junction, the transistor begins to conduct, with a very rapid rise in current.



A sample was put together with two random 1N752A's and a 2N3392 with a d.c. beta of 200, and the dynamic impedance was less than 13 ohms throughout the range from 5 to 30 mA. The terminal voltage was adjustable from 11 to 13 volts. ▲

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Color TV for 1971

(Continued from page 26)

steep side of the sawtooth is reached. The pulse produced is therefore narrow. And so is the band of blue at the top of the picture.

The band of blue appears only when the viewer's hand is brought near the fine-tuning knobs. The human body accumulates hum and noise signals and capacitive pickup feeds those signals through a transistor stage that amplifies and rectifies them at the same time. The resultant d.c. voltage operates a switching transistor, which triggers a gate-switch transistor.

The pulse gate is off unless the gate switch turns it on, regardless of the d.c. level from the gate drivers of the sawtooth from the vertical sweep. When there's no hum-and-noise signal from the viewer's hand, the pulse gate has no output. No blue band appears at the top of the screen.

Sylvania has its first all-transistor chassis, the E01, ready for the 1971 line. The chassis has almost five dozen transistors, a solid-state h.v. rectifier, and a varactor tuner.

This chassis has a green matrix amplifier following transistor *X-Z* demodulation. Each color has its own driver and output transistors. That totals seven stages for the three colors. The *Y* signal is added to the color-difference signals in the color-output stages, rather than at the picture tube. This is common in transistor color sets.

The d.c.-operated volume, tint, and color controls are a part of this chassis. They are similar to those already described. For remote control, the memory-module system is used. This system was pioneered by *Motorola* a couple of years ago and has been adopted by several others since.

Finally, *Zenith* joins the list of U.S. manufacturers offering an all-transistor color set. This chassis has a unique feature: virtually the entire color section is in three IC's.

Besides the five domestic and three import brands that sport all solid-state design, quite a few have most of their stages operated by transistors. U.S. chassis that are predominantly transistor include *Admiral* portables; the *Magnavox* T936; *Motorola* Quasar II; *Packard Bell* C93266, C95242, C95243, and C95266; *Philco-Ford* 19FT60, 20HT70-71, and 20KT40-41; *Sylvania* D12, D15, and D16; and the *Zenith* 4B25C19. Also, some imported color chassis have more transistors than tubes: *Electrohome* C9; *Midland* 15-211; *Panasonic* CT25P, CT98D, CT601, and CT602; and *Sharp* C6010.

It's interesting to analyze which stages still use tubes in these mostly transistor hybrids. They represent the stages that are hardest to transistorize.

In all hybrids, the horizontal sweep and high-voltage sections have retained tubes; likewise the vertical-sweep section. These sections have high power and voltage needs.

In most hybrids, color-difference amplifiers that drive the color CRT are triode tubes. Fairly high amplification is needed, with broad frequency response. Instantaneous amplitudes are high in some color pictures. Transistors to handle these requirements are available, but tubes are usually less expensive. It generally takes two transistors per color to drive the CRT.

Other tube stages are the color oscillator in a few chassis, the video output in some, and the audio output in a couple of others.

It's easy to conclude that solid-state chassis will dominate the color-TV market by this time next year. The surprise is that integrated circuits are not handling more of the solid-state jobs.

Next month, we will describe the use of IC's in color sets, along with other solid-state components, such as varactors for tuning and semiconductor h.v. rectifiers. The increasing use of automatic tint circuits will also be covered.

(Concluded Next Month)

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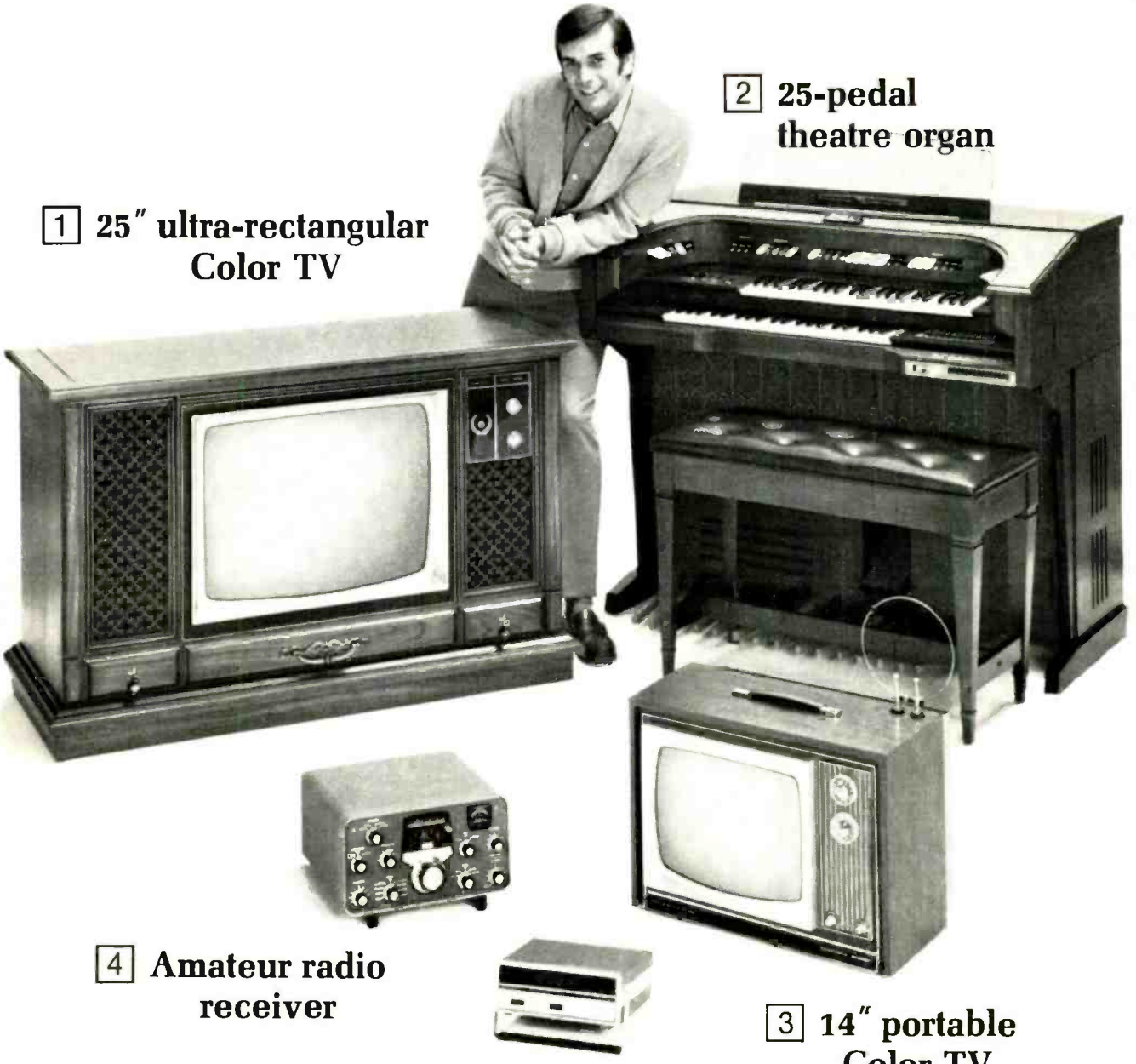

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4 Amateur radio receiver

3 14″ portable Color TV

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By RONALD L. CARROLL

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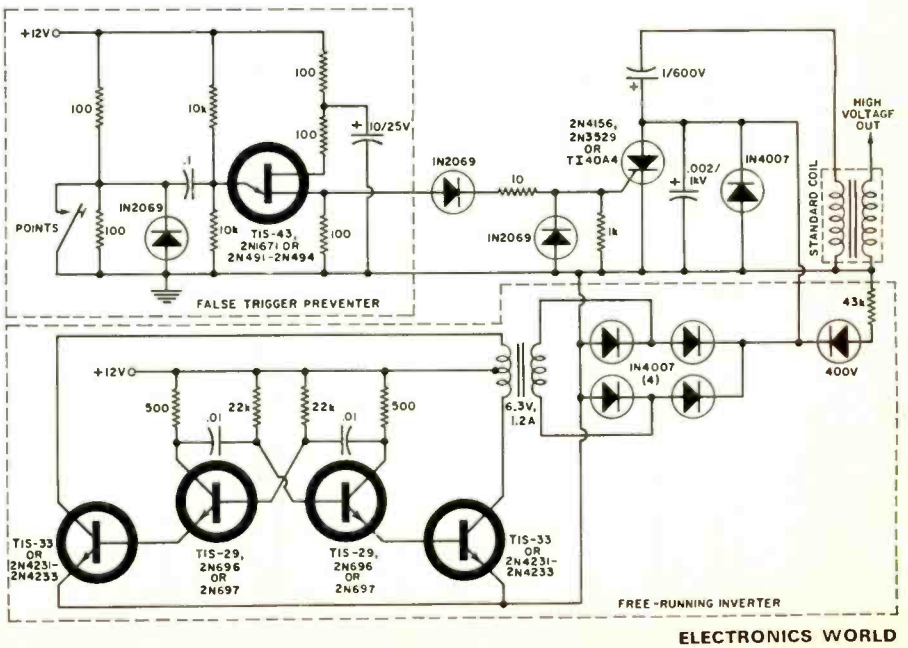
In a conventional CDS the high-*Q* transformer and its attendant low d.c. resistance are responsible for its high input power. The free-running approach permits the use of a transformer with more resistance and, hence, less input power is required. Accordingly, the entire circuit can be smaller with less heat-sinking required. The TIS-33's should, however, have some degree of heat-sinking. The included circuit will produce 30-40 kV at 0.5-0.6 kHz while drawing less than 200 mA.

Although the author used *Texas Instruments* devices for good performance at low cost, alternative numbers are given in each instance in case *TI* products are not available locally. ▲

Schematic diagram of circuit designed to eliminate two common CDS performance faults.



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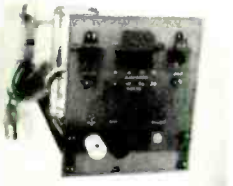

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200	.80	1.25	1.40
300	1.10	1.60	1.80
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100	.07
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400	.11
600	.16
800	.20
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1A*	—	.03	.04	.06	.08	.10	.14	.17	.22
18A**	.09	.15	.19	.29	.39	—	—	—	—
20A	.23	—	—	.59	.75	1.13	1.35	1.73	2.10
40A	.38	—	—	1.35	1.80	2.25	2.70	3.15	3.60

*Tophat, Flangeless. **Pressfit. 3, 20, 40 Studs

Silicon Controlled Rectifiers

1500 PIV RECT. STUD 1 AMP 25¢ EA.

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1A*	—	—	—	.30	.55	.85
7A	.11	.14	.20	.45	.90	1.20
18A**	.15	.23	.35	.60	1.10	1.40
20A	.18	.32	.45	.70	1.15	1.95

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ELECTRONICS WORLD

February 1971

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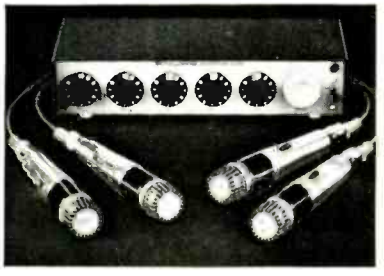

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